model1

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Model 1 - Stacking

This is project for model 1 including Stacking. Here we need to import libraries and dataset and libraries firstly.

```
#Import libraries and dataset
library(tidymodels)
library(caret)
library(caretEnsemble)
library(readr)
library(ggplot2)
library(tidyverse)
library(rpart)       # for fitting decision trees
library(ipred)       # for fitting bagged decision trees
library(pROC)
library(h2o)
library(ggcorrplot)
library(ROCR)
library(recipes)

remotes::install_github("kforthman/caretStack")
```

```
#Import the dataset
radio_df <- read.csv("radiomics_completedata.csv")
```

Preprocess the data

```
# set.seed(75)
```

Check null value

```
is.null(radio_df)
```

```
## [1] FALSE
```

```
sum(is.na(radio_df))
```

```
## [1] 0
```

```
# No null and na values
```

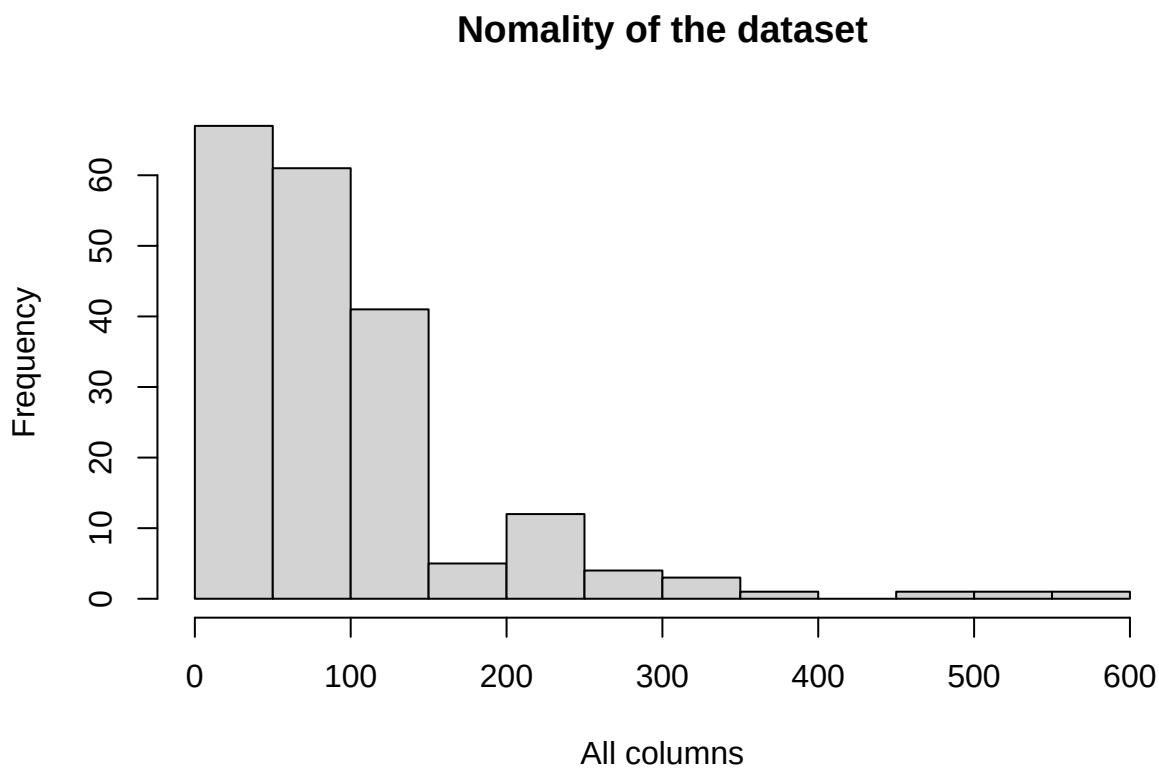
```
#If there is a missing value, simply omit them in this case
#Remove invisible() to show the resutls of omit because the output is too long
invisible(na.omit(radio_df))
```

Check for normality, if not, normalize the data

```
#Use Q-Q plot to see is the data is normally distributed
#Since there are multi-variables in the dataset, so need to use mvnTest

#Define the plot size
par(mfrow=c(1,1))

#create histogram for whole datasets to check the normality
hist(radio_df$GLNU_align.H.PET, xlab = 'All columns', main = paste("Nomality of the dataset"))
```



```
#create a Q-Q plot
# mvn(radio_df_subset, mvnTest = c("dh"), multivariatePlot = c("persp"))
```

Normalize the data

```
#Scale all the columns except the categorical variables
scaled_df <- scale(radio_df[3:431])
head(as.data.frame(scaled_df))
```

```
##      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 Skewness_hist.PET
## 1    -0.4204856        -0.2625994                  -0.2362506        -0.3229376
## 2     0.3153953         0.3949731                   0.2970175        -0.1769772
## 3    -1.1362283        -0.8957972                  -1.1289710        -0.9586986
## 4    -0.3486295        -0.2802885                  -0.2534091        -0.1155757
## 5    -1.1155134        -0.9335606                  -1.2398300         0.9580073
## 6    -1.2048611        -0.9289185                  -1.2246350        -0.4355546
##   Kurtosis_hist.PET Energy_hist.PET Entropy_hist.PET AUC_hist.PET  H_suv.PET
## 1        -0.2730969      0.05021980       -0.3798553   -0.5675836 -0.1211439
## 2        -0.2664840      0.09191129       -0.7468252   -0.5634659  0.9495392
## 3        -0.4718456      0.04744499       -0.3704894   -0.5814501 -1.0718855
## 4         0.1199784     -0.01242149       -0.1570421   -0.4067915 -0.3934530
## 5         0.9071980      0.15326924       -0.8531740   -0.4082919 -1.2107989
## 6        -0.1910724      0.05514509       -0.1536498   -0.5643056 -1.1009679
##    Volume.PET X3D_surface.PET ratio_3ds_vol.PET ratio_3ds_vol_norm.PET
## 1 -0.77134265      -0.5201102        -0.2282413           -0.376749051
## 2 -0.86978222      -0.4310874         0.4221576            0.001181975
## 3 -0.48494090      -0.1551558        -0.2483619           -0.113559448
## 4  0.05871532       0.2442709        -0.7007345           -0.069268090
## 5 -0.42285136      -0.4502135         0.4091793           -0.004442091
## 6 -0.76048331      -0.3917880        -0.0350387           -0.185715505
##   irregularity.PET tumor_length.PET Compactness_v1.PET Compactness_v2.PET
## 1       -0.4041462       -0.4993850        -0.07197872         -0.4249126
## 2       -0.2594920       -0.6246547        -0.08449944         -0.4265812
## 3       -0.5006828       -0.3144097        -0.08158664         -0.4262617
## 4       -0.7786312        0.3678334        -0.08276045         -0.4263918
## 5       -0.3960864       -0.6910089        -0.08436902         -0.4265693
## 6       -0.4839717       -0.4467293        -0.07941290         -0.4259895
##   Spherical_disproportion.PET Sphericity.PET Asphericity.PET Center_of_mass.PET
## 1                -0.376749051     -0.4428932     -0.36463396        -0.03050325
## 2                 0.001181975     -0.5051973      0.02005061        -0.32639266
## 3                -0.113559448     -0.4897787     -0.09674122        -0.58411455
## 4                -0.069268090     -0.4960147     -0.05165838         0.04330285
## 5                -0.004442091     -0.5044949      0.01432605        -0.40817644
## 6                -0.185715505     -0.4787394     -0.17018669        -0.69694662
```

```
##   Max_3D_diam.PET Major_axis_length.PET Minor_axis_length.PET
## 1     -0.66406536           -0.77986887            -0.8104678
## 2     -0.75236400           -0.76712458            -0.7488362
## 3     -0.53368216           -0.45235010            -0.6156914
## 4     -0.05279069           -0.06489845             0.4300517
## 5     -0.79913502           -0.74622189            -0.8991212
## 6     -0.62695008           -0.57774168            -0.5623790
##   Least_axis_length.PET Elongation.PET Flatness.PET Max_cooc.L.PET
## 1            -0.5530902     -0.3767912    0.0388863     0.01907240
## 2            -0.7395741     -0.3002178   -0.3471572     0.13070498
## 3            -0.4296651     -0.6833310   -0.4444301     0.01953020
## 4             0.7399041     -0.1112560    0.3031255     0.05256218
## 5            -0.7280052     -0.6012065   -0.3723581     0.10827282
## 6            -0.9903323     -0.4089789   -1.0862675     0.03231337
##   Average_cooc.L.PET Variance_cooc.L.PET Entropy_cooc.L.PET DAVE_cooc.L.PET
## 1        -0.38679684         -0.10747089         -0.4982927     -0.32209112
## 2        -0.47577094          0.09064602         -0.5860237      0.01715114
## 3         0.01393894         -0.07644599         -0.4564828     -0.25478670
## 4        -0.85110310         -1.08067728         -0.5975811     -1.01842876
## 5        -1.07572238         -0.70694040         -0.6879367     -0.57943763
## 6        -0.34383121         -0.33459330         -0.4952102     -0.35338811
##   DVAR_cooc.L.PET DENT_cooc.L.PET SAVE_cooc.L.PET SVAR_cooc.L.PET
## 1      -0.4376118      -0.4886194     -0.38709402     -0.02670287
## 2       0.2839811      -0.3924968     -0.47610489     -0.05030249
## 3      -0.4201798      -0.4853888      0.01380756      0.01642425
## 4      -1.0814113      -0.7736715     -0.85159235     -1.03759534
## 5      -0.5145756      -0.5799860     -1.07630456     -0.76817505
## 6      -0.3880621      -0.5037470     -0.34411057     -0.33550372
##   SENT_cooc.L.PET ASM_cooc.L.PET Contrast_cooc.L.PET Dissimilarity_cooc.L.PET
## 1      -0.4370125     0.08567996          -0.2213217              -0.32209112
## 2      -0.4522504     0.09647507           0.3022677               0.01715114
## 3      -0.4160760     0.08186129          -0.2136907              -0.25478670
## 4      -0.5918277     0.09955938          -1.0037577              -1.01842876
## 5      -0.6137263     0.11134587          -0.5146244              -0.57943763
## 6      -0.4628880     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 GLNU_area.L.PET
## 1  -0.2984560 -0.17106728  -0.2942719 -0.15397307 -0.18606625      -0.5527994
## 2  -0.3730995 -0.09242262  -0.3163762 -0.18984205 -0.54236685      -0.5773325
```

```
## 3   0.2138548 -0.44960709   0.2507497 -0.67073190 -0.04279253      -0.5580437
## 4  -0.8741513 -0.39730122  -0.8709436 -0.29205659 -0.65872610       0.7972658
## 5  -1.1420153  0.44865547  -1.0646965 -0.02980072 -1.18830026      -0.5331460
## 6  -0.2275594 -0.43201249  -0.2525831 -0.40630438 -0.17656210      -0.5487210
##   ZSNU.L.PET  ZSP.L.PET GLNU_norm.L.PET ZSNU_norm.L.PET GLVAR_area.L.PET
## 1 -0.5530418 -0.5621738     -0.23689556      -0.6190040     -0.121204529
## 2 -0.5984956 -0.4628174     -0.09957407      -0.4177144      0.000753596
## 3 -0.5054842 -0.4019440     -0.31340711      -0.3386244      0.026274426
## 4  0.7243773 -0.6566870     -0.11705626      -0.7292502     -1.045590634
## 5 -0.5925559 -0.4268835      0.12451086      -0.3925193     -0.907213368
## 6 -0.5364744 -0.5302461     -0.25610439      -0.5629950     -0.293935425
##   ZSVAR.L.PET Entropy_area.L.PET Max_cooc.H.PET Average_cooc.H.PET
## 1  -0.2226564         -0.5000553     -0.5622647        -0.62173115
## 2  -0.4137605         -0.6362274     -0.4644195        -0.65760120
## 3  -0.8362779         -0.5442329      0.5340130        -0.34277170
## 4   0.4721232         -0.4937376     -0.4910382        -0.71683325
## 5  -0.7751321         -0.7925323      2.5493588        -0.09109055
## 6  -0.3715063         -0.5139189      0.9182000        -0.26774039
##   Variance_cooc.H.PET Entropy_cooc.H.PET DAVE_cooc.H.PET DVAR_cooc.H.PET
## 1          -0.3926613         -0.4405901      -0.4245348      -0.5066538
## 2          -0.3614375         -0.1978581      -0.2002922      -0.3071158
## 3          -0.6153275         -1.2304855      -0.6542876      -0.3422576
## 4          -0.2257862         -0.4815188      -0.5565737      -0.5352219
## 5          -1.8853813         -1.4739615      -1.4624814      -1.5091037
## 6          -1.0272260         -1.3894649      -0.9100846      -0.4729899
##   DENT_cooc.H.PET SAVE_cooc.H.PET SVAR_cooc.H.PET SENT_cooc.H.PET
## 1      0.08192889     -0.57021320     -0.21121323      0.07030056
## 2     -0.83264259     -0.69322153     -0.51771839      0.21849474
## 3     -0.01496272     -0.28179187     -0.04897359     -0.73909827
## 4     -0.06855070     -0.66854100     -0.06049054      0.03408701
## 5     -0.27142899     -0.02157412     -0.22370520     -0.99227968
## 6     -1.36710074     -0.20421566     -1.12758322     -0.90558682
##   ASM_cooc.H.PET Contrast_cooc.H.PET Dissimilarity_cooc.H.PET
## 1     -0.4257044          -0.4150674               -0.4245348
## 2     -0.4923348          -0.1059010               -0.2002922
## 3      0.5293038          -0.5606912               -0.6542876
## 4     -0.3939640          -0.5503855               -0.5565737
## 5      2.2056453          -1.5501224               -1.4624814
## 6      1.1479491          -0.8152598               -0.9100846
##   Inv_diff_cooc.H.PET Inv_diff_norm_cooc.H.PET IDM_cooc.H.PET
## 1          -0.6699941               -0.5752921     -0.6523898
## 2          -0.8857913               -0.6152984     -0.8819195
## 3           0.3565728               -0.5209539      0.5268363
## 4          -0.4667711               -0.5490693     -0.4271592
## 5           1.0615198               -0.3715120      1.2525912
## 6           0.7501870               -0.4686586      0.9497298
##   IDM_norm_cooc.H.PET Inv_var_cooc_.H.PET Correlation_cooc.H.PET
## 1          -0.5628068           0.1245932             -0.2531664
## 2          -0.5876552           0.1626292             -0.7097902
## 3          -0.5524530          -0.4195061             -0.3204338
## 4          -0.5507795           0.1827693              0.1572312
## 5          -0.4665595          -0.1515276             -0.8038649
## 6          -0.5320201          -0.4759560             -0.5377799
##   Autocorrelation_cooc.H.PET Tendency_cooc.H.PET Shade_cooc.H.PET
```

```
## 1               -0.63574265         -0.34548858       0.56115327
## 2               -0.72995330         -0.46719366      -0.03213742
## 3               -0.12798663         -0.58987505      -0.06440384
## 4               -0.75877292         -0.03028623      -0.39054358
## 5                0.31634762         -1.89802896       1.54978365
## 6               -0.01075648         -1.04995447       0.53842843
##   Prominence_cooc.H.PET IC1_d.H.PET IC2_d.H.PET Coarseness_vdif.H.PET
## 1            -0.2771646  0.45844723 -0.34880559            0.09720863
## 2            -0.3832531  0.84097312 -0.70922702            0.12838981
## 3            -0.7224845  0.08064715 -0.49617333            0.06302159
## 4             0.3271375 -0.02579697  0.03019033            0.04310330
## 5            -1.7264583  0.44273864 -0.93060958            0.08210694
## 6            -1.2412690  0.22017194 -0.70937241            0.05664774
##   Contrast_vdif.H.PET Busyness_vdif.H.PET Complexity_vdif.H.PET
## 1          -0.4274453          -0.3638887           -0.10931813
## 2          -0.5671546          -0.3703971            0.06155045
## 3           0.7225133          -0.3477636           -0.19946129
## 4          -0.4836185          -0.2468294           -0.23521590
## 5          -0.5418056          -0.3667598           -0.72923006
## 6           1.0600966          -0.3404997           -0.27546607
##   Strength_vdif.H.PET SRE_align.H.PET LRE_align.H.PET RLNU_align.H.PET
## 1         -0.13025494      -0.4307026      -0.7195651       -0.4971654
## 2         -0.09260654      -0.3447791      -0.9067290       -0.5420981
## 3         -0.11406009      -0.7812458       0.3824637       -0.5852595
## 4         -0.23919622      -0.5220265      -0.4651246        0.7194380
## 5          0.08722946      -0.8618153       0.6020573       -0.6316801
## 6         -0.11599525      -0.9130679       1.0286387       -0.6029308
##   RP_align.H.PET LGRE_align.H.PET HGRE_align.H.PET LGSRE_align.H.PET
## 1     -0.4065909       0.06392089     -0.698132947        0.06778299
## 2     -0.2896583       0.06421447     -0.740884690        0.06870144
## 3     -0.8520852       0.03404939     -0.378161662        0.03611506
## 4     -0.5294515       0.10054467     -0.674598529        0.09794468
## 5     -0.9156443       0.01379255      0.456615365        0.01822378
## 6     -0.9873040       0.02311363     -0.008001338        0.02524069
##   HGSRE_align.H.PET LGHRE_align.H.PET HGLRE_align.H.PET GLNU_norm_align.H.PET
## 1       -0.59041968       0.037835342        -0.6802823            -0.5712362
## 2       -0.53088745       0.033125985        -0.8573161            -0.7030578
## 3       -0.76247426       0.027942041         0.6873551             0.5316701
## 4       -0.65688536       0.117419836        -0.4979682            -0.6317852
## 5        0.09512599      -0.005644076         1.0274090             1.5299799
## 6       -0.48738896       0.028964227         1.2343204             0.9385123
##   RLNU_norm_align.H.PET GLVAR_align.H.PET RLVAR_align.H.PET Entropy_align.H.PET
## 1            -0.3120397        -0.3721453        -0.5834915          -0.4736414
## 2            -0.1079673        -0.4355544        -0.8037182          -0.3905964
## 3            -0.9704621        -0.6625075         0.7441584          -0.8867673
## 4            -0.5049737        -0.1576847        -0.2617379          -0.2985495
## 5            -1.0850209        -1.8601022         0.9596641          -1.0911927
## 6            -1.1496499        -0.9735944         1.4877490          -0.8924170
##    SZSE.H.PET  LZSE.H.PET LGLZE.H.PET HGLZE.H.PET SZLGE.H.PET   SZHGE.H.PET
## 1 -0.34821000 -0.20713789 0.054010198  -0.2901933  0.06374556 -3.657487e-01
## 2  0.08296996 -0.21972745 0.057224946  -0.7831293  0.07546816 -9.234150e-02
## 3 -0.85184571 -0.11558937 0.031689625  -0.3822321  0.04154588 -9.771746e-01
## 4 -0.46659449 -0.14463396 0.093281256   0.5268357  0.08796006 -5.579603e-01
## 5 -0.98364474  0.01824329 0.007396366   0.7261377  0.02594017 -2.874186e-05
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## 6 -0.98401691  0.20956309 0.019378605  -0.1268240  0.03231433 -7.223679e-01
##   LZLGE.H.PET  LZHGE.H.PET GLNU_area.H.PET ZSNU.H.PET  ZSP.H.PET
## 1  -0.2540270 -0.233853915      -0.5444686 -0.4601965 -0.2248134
## 2  -0.2869748 -0.243886393      -0.5796658 -0.3824687  0.5127672
## 3  -0.2005686 -0.095484736      -0.4288636 -0.5618607 -0.9285878
## 4  -0.0380075 -0.186879336       0.5390657  0.1940260 -0.6128852
## 5  -0.1199001  0.006637164      -0.5810817 -0.5874970 -1.1161831
## 6   0.1643966  0.194571350      -0.5459613 -0.5864810 -1.2948336
##   GLNU_norm.H.PET ZSNU_norm.H.PET GLVAR_area.H.PET ZSVAR_H.PET
## 1      -0.5806037      -0.3162951       -0.4224700 -0.22265827
## 2      -0.6979911       0.5518249       -0.4601605 -0.23141569
## 3       0.7417602      -1.0206540       -0.7321688 -0.14238329
## 4      -0.6306111      -0.5107478       -0.1013358 -0.15967750
## 5       0.8761277      -1.1255136       -1.7481942 -0.01198442
## 6       1.0030056      -1.1804675       -0.8220885  0.15839447
##   Entropy_area.H.PET Max_cooc.W.PET Average_cooc.W.PET Variance_cooc.W.PET
## 1         -0.4736178     -0.3461950        -0.31008562          -0.2564173
## 2         -0.6802143     -0.3036564         0.02683964           0.4493676
## 3         -0.7186979      0.2207037        -1.03175940          -0.8969181
## 4         -0.2259535     -0.3351671        -0.24731569          -0.3130037
## 5         -0.7802805      1.4412203        -1.25206094          -0.9213654
## 6         -0.7566641      0.5149649        -1.16802267          -0.9303583
##   Entropy_cooc.W.PET DAVE_cooc.W.PET DVAR_cooc.W.PET DENT_cooc.W.PET
## 1         -0.3380333      -0.2540337      -0.3193107    -0.342943902
## 2         -0.1736199       0.5364988       0.6942880     0.002238598
## 3         -1.0345685      -1.1339433      -0.9433432    -1.093835590
## 4         -0.3440762      -0.4552820      -0.4197731    -0.444514652
## 5         -1.2576617      -1.2034308      -0.9378081    -1.135682315
## 6         -1.1793425      -1.2258890      -0.9628533    -1.208596176
##   SAVE_cooc.W.PET SVAR_cooc.W.PET SENT_cooc.W.PET ASM_cooc.W.PET
## 1     -0.31038212      -0.2282020      -0.3159465     -0.2006869
## 2      0.02661683       0.3098894      -0.1467601     -0.2333697
## 3     -1.03221397      -0.8431674      -0.9419763      0.3324825
## 4     -0.24759852      -0.2424063      -0.3128799     -0.1888046
## 5     -1.25256366      -0.8712021      -1.1559564      1.2294011
## 6     -1.16850700      -0.8775841      -1.0917096      0.6973497
##   Contrast_cooc.W.PET Dissimilarity_cooc.W.PET Inv_diff_cooc.W.PET
## 1          -0.3075340               -0.2540337          -0.6374300
## 2           0.7742948                0.5364988          -0.9304053
## 3          -0.9576910               -1.1339433           0.2901524
## 4          -0.4700373               -0.4552820          -0.4626158
## 5          -0.9705620               -1.2034308           0.5487330
## 6          -0.9855880               -1.2258890           0.5258770
##   Inv_diff_norm_cooc.W.PET IDM_cooc.W.PET IDM_norm_cooc.W.PET
## 1               -0.5764903     -0.6315742          -0.5654455
## 2               -0.6353259     -0.9114075          -0.6095647
## 3               -0.5694748      0.5091234          -0.5606607
## 4               -0.4639086     -0.4247365          -0.5072004
## 5               -0.5218385      0.8605536          -0.5446135
## 6               -0.5432064      0.8382954          -0.5500768
##   Inv_var_cooc.W.PET Correlation_cooc.W.PET Autocorrelation_cooc.W.PET
## 1         -0.5757397             -0.2399351                -0.32079144
## 2         -0.9126200             -0.8269017                 0.03559253
## 3          0.5282510             -0.2251579                -0.85647530
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## 4         -0.3646175              0.1173220               -0.25478504
## 5          0.6301697             -0.6005036               -0.93362150
## 6          0.7959910             -0.4364399               -0.90992639
##   Tendency_cooc.W.PET Shade_cooc.W.PET Prominence_cooc.W.PET IC1_d.W.PET
## 1          -0.2282020      -0.19389610           -0.24361420   0.5027180
## 2           0.3098894      -0.07709063           -0.06025639   0.4614179
## 3          -0.8431674      -0.38075702           -0.33892430   0.2495240
## 4          -0.2424063      -0.12206509           -0.20994984   0.1738307
## 5          -0.8712021      -0.36726449           -0.33872045   0.7187278
## 6          -0.8775841      -0.37810446           -0.33964929   0.4437719
##   IC2_d.W.PET Coarseness_vdif.W.PET Contrast_vdif.W.PET Busyness_vdif.W.PET
## 1  -0.4267892         -0.0550313004          -0.1846450          -0.6979653
## 2  -0.3295264         -0.0353358511           0.9808822          -0.8409454
## 3  -0.5747430          0.0153602863          -0.8804405           0.3359712
## 4  -0.1890252         -0.3110467938          -0.8000340          -0.2967495
## 5  -1.0350664          0.0257529944          -1.0090603           0.7166976
## 6  -0.7867358          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
## 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
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## 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 Min_hist.ADC
## 1      -0.3200057       -0.2766605 -0.38203018         -0.5014727    0.4113126
## 2       0.1255877        0.3303703 -0.43457258         -0.5477755   -0.8657505
## 3      -0.8898751       -0.8956246  0.03827969         -0.8589846    0.6090364
## 4      -0.5494782       -0.2378244 -0.23636331         -0.2711087   -0.8657505
## 5      -1.0798617       -0.9244211  0.02117985         -0.9273561   -0.8657505
## 6      -1.1754135       -0.9261313  0.79391402         -0.7747854   -0.8657505
##   Max_hist.ADC Mean_hist.ADC Variance_hist.ADC Standard_Deviation_hist.ADC
## 1  -0.54142188    -0.3871858        0.03649101                  -0.13239011
## 2  -0.59178935    -0.5187498       -0.35175571                  -0.42773754
## 3  -0.01830709    -0.3635494        1.08498263                   0.51133519
## 4  -0.01035433    -0.4584202        0.28753584                   0.03833017
## 5  -0.43450146    -0.7453425       -0.00565879                  -0.16242576
## 6  -0.33818472    -0.2100562        2.18699161                   1.05521496
##   Skewness_hist.ADC Kurtosis_hist.ADC Energy_hist.ADC Entropy_hist.ADC
## 1         0.7601872        -0.3645347      0.17139759       -0.8808510
## 2        -1.3132101         0.3555531      0.08084621       -0.6160912
## 3         1.4014854         0.8837421      0.05339560       -0.4708601
## 4        -0.3335022        -0.4827438      0.03164901       -0.3251680
## 5        -0.2284111        -0.2927585      0.06337764       -0.5427299
## 6        -0.9234665        -1.3820906      0.04876108       -0.4722479
##   AUC_hist.ADC  Volume.ADC X3D_surface.ADC ratio_3ds_vol.ADC
## 1   -0.5517312 -0.77171573     -0.83357781        0.40738565
## 2   -0.6811442 -0.83529619     -0.72636952       -0.20351364
## 3   -0.3709215 -0.51840678     -0.56229596       -0.51516250
## 4   -0.5582428  0.05016931     -0.07719641       -0.52782472
## 5   -0.6274542 -0.48828960     -0.55940723       -0.47939174
## 6   -0.6852396 -0.73987664     -0.52085076       -0.05784537
##   ratio_3ds_vol_norm.ADC irregularity.ADC Compactness_v1.ADC Compactness_v2.ADC
## 1             -0.5102350       -0.3109450       -0.159269319        -0.56541295
## 2             -0.7309093       -0.5307282       -0.015731983         0.01693002
## 3             -0.7887529       -0.7548838        0.029338740         0.21805452
## 4             -0.3401354       -0.6841516       -0.247114169        -0.87441235
## 5             -0.7465117       -0.7114444       -0.003961922         0.06881245
## 6             -0.2591402       -0.5710146       -0.283572652        -0.99205523
##   Spherical_disproportion.ADC Sphericity.ADC Asphericity.ADC Center_of_mass.ADC
## 1                  -0.5102350     -0.5761452     -0.32810533         -0.1599647
## 2                  -0.7309093     -0.3377117     -0.79595554         -0.1345429
## 3                  -0.7887529     -0.2658503     -0.91858954          0.3122768
## 4                  -0.3401354     -0.7287679      0.03252177          0.1652700
## 5                  -0.7465117     -0.3187759     -0.82903405         -0.5223026
## 6                  -0.2591402     -0.7938125      0.20423907          0.4204525
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##   Max_3D_diam.ADC Major_axis_length.ADC Minor_axis_length.ADC
## 1      -0.9223406            -0.6363554            -1.0694709
## 2      -0.7388407            -0.9347200            -0.7650734
## 3      -0.6298715            -0.7330537            -0.4762489
## 4      -0.2750518            -0.2806023            -0.2509627
## 5      -0.7007593            -0.8147554            -0.5239350
## 6      -0.5900804            -0.4516336            -0.5552712
##   Least_axis_length.ADC Elongation.ADC Flatness.ADC Max_cooc.L.ADC
## 1           -1.04883852     -1.2658333   -1.2879681    0.171468447
## 2           -0.59483948     -0.2578859    0.0237260   -0.034142536
## 3           -0.49092760     -0.1144291   -0.1805273    0.040404448
## 4           -0.07836234     -0.4660035   -0.2184426    0.008852003
## 5           -0.25589410     -0.0340415    0.4388721   -0.001549901
## 6           -0.67678823     -0.6741211   -0.8646448   -0.110769901
##   Average_cooc.L.ADC Variance_cooc.L.ADC Entropy_cooc.L.ADC DAVE_cooc.L.ADC
## 1        -0.72089326           0.5592857         -0.6503058      0.10801881
## 2        -0.04429305          -0.7145134         -0.6089983     -0.58519579
## 3        -1.19070915           0.9512078         -0.5126260     -0.21463352
## 4        -0.58873748          -0.7749119         -0.6127855     -0.86737881
## 5        -0.53186871          -0.6271330         -0.5521907     -0.48832913
## 6        -0.10171762           1.2476170         -0.3423719      0.05653072
##   DVAR_cooc.L.ADC DENT_cooc.L.ADC SAVE_cooc.L.ADC SVAR_cooc.L.ADC
## 1       1.3404697      -0.3378751      -0.7211984       0.4168868
## 2      -0.6443482      -0.6023649      -0.0444083      -0.7316081
## 3       0.9153432      -0.4453804      -1.1911468       1.1761980
## 4      -0.9051946      -0.7262579      -0.5890055      -0.6872803
## 5      -0.5937073      -0.5615696      -0.5321207      -0.6497936
## 6       0.5625945      -0.3536147      -0.1018483       1.5473657
##   SENT_cooc.L.ADC ASM_cooc.L.ADC Contrast_cooc.L.ADC Dissimilarity_cooc.L.ADC
## 1     -0.21422274     0.11178526           0.8024997               0.10801881
## 2     -1.15215699     0.07978965          -0.5875537              -0.58519579
## 3      0.07552317     0.08346730           0.3370790              -0.21463352
## 4     -0.18692032     0.08199624          -0.8708007              -0.86737881
## 5     -0.21904233     0.06728562          -0.4988646              -0.48832913
## 6     -0.82480441     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 Prominence_cooc.L.ADC
## 1             -0.6998238           0.4168868    1.5643914             0.9559151
## 2              0.2354008          -0.7316081   -0.8436388            -0.6151097
## 3             -1.1120988           1.1761980    4.1522294             3.9832025
## 4             -0.5602964          -0.6872803   -0.3582556            -0.7096757
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## 5             -0.4952326          -0.6497936   -0.3648893            -0.6136209
## 6              0.2695015           1.5473657   -1.0298872             1.2401564
##   IC1_.L.ADC  IC2_.L.ADC Coarseness_vdif_.L.ADC Contrast_vdif_.L.ADC
## 1 -0.6883999  0.02448574            0.301907443            0.6409048
## 2  0.5967581 -0.55782502            0.056613103           -0.4518571
## 3  0.1773429 -0.27185532           -0.075963314           -0.0702796
## 4  0.3808910 -0.41652989           -0.139734248           -0.6427148
## 5  0.6439494 -0.57515917            0.008225508           -0.3561751
## 6 -0.1924172 -0.05807723           -0.003801467            0.3844799
##   Busyness_vdif_.L.ADC Complexity_vdif_.L.ADC Strength_vdif_.L.ADC
## 1           -0.6365437              0.2240702           1.08878436
## 2           -0.6250681             -0.8182427          -0.05349273
## 3           -0.1905094              0.5372433           0.06221020
## 4           -0.2282567             -0.9070155          -0.48069605
## 5           -0.5381510             -0.6730924          -0.20159009
## 6           -0.5798298              0.2904589          -0.09788725
##   SRE_align.L.ADC LRE_align.L.ADC GLNU_align.L.ADC RLNU_align.L.ADC
## 1      -0.5432046      -0.6178635       -0.6261970       -0.6678444
## 2      -0.5458232      -0.6137933       -0.5441134       -0.5747492
## 3      -0.5607702      -0.5566774       -0.4608465       -0.4549755
## 4      -0.5791469      -0.4858621       -0.1783430       -0.1430350
## 5      -0.5426021      -0.6154515       -0.5346359       -0.5426892
## 6      -0.5308298      -0.6668765       -0.5690912       -0.5195656
##   RP_align.L.ADC LGRE_align.L.ADC HGRE_align.L.ADC LGSRE_align.L.ADC
## 1     -0.5353171     6.109942e-02      -0.54292539       0.067623844
## 2     -0.5400544    -3.801424e-02       0.06789313      -0.030420066
## 3     -0.5598945     2.092792e-01      -1.12656204       0.206135542
## 4     -0.5840029     2.904285e-02      -0.62025951       0.029459100
## 5     -0.5370995    -6.973871e-05      -0.53892281       0.007086664
## 6     -0.5193700    -4.259375e-02       0.35906171      -0.035355162
##   HGSRE_align.L.ADC LGHRE_align.L.ADC HGLRE_align.L.ADC GLNU_norm_align.L.ADC
## 1       -0.52408648        0.02829577        -0.6071760            -0.1203279
## 2        0.06957377       -0.07624384         0.0513619            -0.1128336
## 3       -1.12804770        0.21305610        -1.1064162            -0.2225712
## 4       -0.63542049        0.03082241        -0.5596155            -0.1730555
## 5       -0.53418758       -0.03644930        -0.5476899            -0.2306008
## 6        0.38423936       -0.07877047         0.2569200            -0.5276951
##   RLNU_norm_align.L.ADC GLVAR_align.L.ADC RLVAR_align.L.ADC Entropy_align.L.ADC
## 1            -0.5125345         0.6524756       -0.44582763          -0.5883206
## 2            -0.5226589        -0.6881227       -0.43730678          -0.6382575
## 3            -0.5600825         0.6739622       -0.24658490          -0.5106176
## 4            -0.6053373        -0.7581559       -0.01198974          -0.5812684
## 5            -0.5127052        -0.5532662       -0.41790827          -0.5837223
## 6            -0.4824053         0.9801508       -0.61298122          -0.3955007
##   SZSE.L.ADC LZSE.L.ADC LGLZE.L.ADC HGLZE.L.ADC  SZLGE.L.ADC SZHGE.L.ADC
## 1 -0.5014454 -0.7450547  0.07253492 -0.52116543  0.087641058  -0.4531762
## 2 -0.5322334 -0.6801099 -0.02713914  0.03776169 -0.008292571   0.0300991
## 3 -0.6485655 -0.2386096  0.20773636 -1.11061311  0.182242275  -1.1424450
## 4 -0.5869649 -0.4695587  0.01990175 -0.63424587  0.014691528  -0.6650952
## 5 -0.5609116 -0.5131342  0.01661218 -0.56442366  0.033678392  -0.5884310
## 6 -0.5031381 -0.7854992 -0.03306038  0.31736403 -0.014621525   0.3350138
##    LZLGE.L.ADC  LZHGE.L.ADC GLNU_area.L.ADC ZSNU.L.ADC  ZSP.L.ADC
## 1 -0.069331476 -0.722525947      -0.6384152 -0.6668395 -0.4462596
## 2 -0.173528216 -0.081345974      -0.5460429 -0.5690748 -0.4875722
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## 3  0.296453924 -0.948870970      -0.4826914 -0.4871185 -0.6694902
## 4  0.001412627 -0.518685568      -0.1566395 -0.1301000 -0.5806975
## 5 -0.124720269 -0.445679435      -0.5424265 -0.5463444 -0.5542942
## 6 -0.178463851  0.008986928      -0.5719915 -0.5041938 -0.4347400
##   GLNU_norm.L.ADC ZSNU_norm.L.ADC GLVAR_area.L.ADC ZSVAR.L.ADC
## 1      -0.1479371      -0.4206376        0.6575768  -0.6125949
## 2      -0.0875094      -0.4944409       -0.6983670  -0.5654684
## 3      -0.2477384      -0.7518699        0.6482625  -0.0599094
## 4      -0.1514916      -0.6179428       -0.7672453  -0.3265400
## 5      -0.2193018      -0.5559436       -0.5238385  -0.3514997
## 6      -0.5039407      -0.4273670        0.9330886  -0.6811584
##   Entropy_area.L.ADC Max_cooc.H.ADC Average_cooc.H.ADC Variance_cooc.H.ADC
## 1         -0.6257851     0.08340477         -0.6642144          -0.6262628
## 2         -0.6568559     0.06727003         -0.3985375          -0.6128917
## 3         -0.4381783     0.14134316         -0.6189469          -0.4471629
## 4         -0.5720668     0.08230468         -0.6063365          -0.6286703
## 5         -0.5622679     0.05736917         -0.5691155          -0.6641421
## 6         -0.4352778     0.09513913         -0.6231404          -0.4813925
##   Entropy_cooc.H.ADC DAVE_cooc.H.ADC DVAR_cooc.H.ADC DENT_cooc.H.ADC
## 1         -0.5135162      -0.4035709      -0.3457743      -0.5427089
## 2         -0.5879123      -0.4490907      -0.5347957      -0.5544867
## 3         -0.5521140      -0.6742298      -0.5346473      -0.6002605
## 4         -0.5364986      -0.8378865      -0.9205151      -0.6518222
## 5         -0.5449454      -0.4736239      -0.4721307      -0.5533171
## 6         -0.5896604      -0.8362281      -0.7161951      -0.6504806
##   SAVE_cooc.H.ADC SVAR_cooc.H.ADC SENT_cooc.H.ADC ASM_cooc.H.ADC
## 1      -0.6645724      -0.7020362      -0.4477105      0.1131243
## 2      -0.3987956      -0.6241406      -0.8491975      0.1057101
## 3      -0.6192882      -0.2874587      -0.4815200      0.1071929
## 4      -0.6066727      -0.3859861      -0.5326087      0.1049686
## 5      -0.5694384      -0.6923536      -0.6034431      0.1053393
## 6      -0.6234836      -0.2260366      -0.6221580      0.1086758
##   Contrast_cooc.H.ADC Dissimilarity_cooc.H.ADC Inv_diff_cooc.H.ADC
## 1          -0.2927716               -0.4035709          -0.5126398
## 2          -0.4138414               -0.4490907          -0.5808371
## 3          -0.6417886               -0.6742298          -0.2457501
## 4          -0.9390283               -0.8378865          -0.2186128
## 5          -0.4160171               -0.4736239          -0.4714618
## 6          -0.8597653               -0.8362281          -0.1572588
##   Inv_diff_norm_cooc.H.ADC IDM_cooc.H.ADC IDM_norm_cooc.H.ADC
## 1               -0.5783293    -0.40456384          -0.5739996
## 2               -0.5733662    -0.54895368          -0.5659544
## 3               -0.5284852    -0.08509688          -0.5433796
## 4               -0.5034298    -0.08864455          -0.5199402
## 5               -0.5669623    -0.37192535          -0.5650898
## 6               -0.4994273    -0.01644963          -0.5240950
##   Inv_var_cooc.H.ADC Correlation_cooc.H.ADC Autocorrelation_cooc.H.ADC
## 1         -0.3372000            -0.63608177                 -0.7706165
## 2         -0.5233714            -0.47456466                 -0.2722283
## 3         -0.1120096            -0.05904703                 -0.5731530
## 4         -0.1261824             0.15083503                 -0.5416515
## 5         -0.3945912            -0.52544743                 -0.5940408
## 6         -0.0437701             0.16376241                 -0.5453615
##   Tendency_cooc.H.ADC Shade_cooc.H.ADC Prominence_cooc.H.ADC IC1_d.H.ADC
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## 1          -0.7020362       0.46889817           -0.74536242 -0.86166650
## 2          -0.6241406      -1.70131741           -0.65856794  0.39133994
## 3          -0.2874587       1.06718493           -0.06008993  0.32513388
## 4          -0.3859861      -0.05494861           -0.37044251  0.47315352
## 5          -0.6923536      -0.73786494           -0.72042827  0.41273734
## 6          -0.2260366      -0.59074557           -0.18983207 -0.06392116
##   IC2_d.H.ADC Coarseness_vdif.H.ADC Contrast_vdif.H.ADC Busyness_vdif.H.ADC
## 1   0.1157107           0.432890709          -0.3950162          -0.6536208
## 2  -0.4319173           0.039522006          -0.4548965          -0.5597792
## 3  -0.3774947          -0.040985354          -0.8123096          -0.4779572
## 4  -0.5048832          -0.118627683          -0.9057013          -0.2214241
## 5  -0.4502685          -0.003453453          -0.4205023          -0.5253460
## 6  -0.1380789           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 LZSE.H.ADC
## 1       -0.5708740       -0.36484507          -0.6043268 -0.5346854 -0.6981364
## 2       -0.5719358       -0.34004504          -0.5926918 -0.5422640 -0.6958561
## 3       -0.5977942        0.12336936          -0.5713589 -0.6095598  0.1545871
## 4       -0.5819026        0.05502511          -0.5597051 -0.5735377 -0.5155250
## 5       -0.5722561       -0.19845421          -0.5843242 -0.5572108 -0.5454259
## 6       -0.5843167       -0.12722623          -0.5780064 -0.5901219 -0.4498940
##     LGLZE.H.ADC HGLZE.H.ADC  SZLGE.H.ADC SZHGE.H.ADC LZLGE.H.ADC LZHGE.H.ADC
## 1  0.0666177435  -0.5767674  0.155938519  -0.5473062  -0.5353574  -0.6768543
## 2  0.0001856309  -0.5725235  0.041762582  -0.5478138  -0.4547178  -0.7175082
## 3 -0.0501129685  -0.6777485 -0.064694419  -0.7376807  -0.1269569   0.9150997
## 4 -0.0861761153  -0.5757788 -0.097821522  -0.5824360  -0.2065126  -0.5488053
## 5 -0.0453678176  -0.6186968  0.006384122  -0.6369542  -0.2160507  -0.4799949
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## 6 -0.1643129334  -0.5594243 -0.157321658  -0.5874992   0.2944499  -0.5599065
##   GLNU_area.H.ADC ZSNU.H.ADC  ZSP.H.ADC GLNU_norm.H.ADC ZSNU_norm.H.ADC
## 1      -0.6642705 -0.6725977 -0.5168683     -0.03152093      -0.4954016
## 2      -0.5751688 -0.5778406 -0.5216097     -0.04041668      -0.5166242
## 3      -0.4667660 -0.4846950 -0.6662111     -0.03316829      -0.6745847
## 4      -0.1441447 -0.1388711 -0.5778396     -0.04239351      -0.5900432
## 5      -0.5478389 -0.5519269 -0.5613757     -0.03876932      -0.5486951
## 6      -0.5333562 -0.5436026 -0.5982111     -0.03975773      -0.6317154
##   GLVAR_area.H.ADC ZSVAR.H.ADC Entropy_area.H.ADC Max_cooc.W.ADC
## 1       -0.5622214 -0.64742792         -0.6439049     0.19349133
## 2       -0.5370231 -0.67651322         -0.6007301     0.08644844
## 3       -0.6936563  2.35951019         -0.5334676     0.08425643
## 4       -0.5806360 -0.24612217         -0.5508851     0.05722171
## 5       -0.5619809 -0.24897717         -0.5892300     0.07658442
## 6       -0.6210024 -0.09837599         -0.5535874     0.07220041
##   Average_cooc.W.ADC Variance_cooc.W.ADC DAVE_cooc.W.ADC DVAR_cooc.W.ADC
## 1        -0.84300136          -0.0154161     -0.13255040      0.61946231
## 2         0.11675254          -0.3782130     -0.33716774     -0.33068080
## 3        -0.93506685           1.3339103      0.14095967      1.55899175
## 4         0.09734604           0.2202409     -0.17910738     -0.03977472
## 5        -0.19741735          -0.1038016     -0.04782845     -0.05742292
## 6         0.33324944           2.4174995      0.83171075      1.81350274
##   DENT_cooc.W.ADC SAVE_cooc.W.ADC SVAR_cooc.W.ADC SENT_cooc.W.ADC
## 1      -0.4834815      -0.8470091      -0.1239002      -0.2297138
## 2      -0.5288387       0.1400958      -0.3998223      -1.1487708
## 3      -0.4091896      -0.9416984       1.3894965       0.1752058
## 4      -0.4771018       0.1201363       0.2845655      -0.0319484
## 5      -0.4533533      -0.1830273      -0.1595859      -0.1411365
## 6      -0.2720697       0.3627625       2.5166759      -0.7842625
##   ASM_cooc.W.ADC Contrast_cooc.W.ADC Dissimilarity_cooc.W.ADC
## 1     0.12046668          0.33932322              -0.13255040
## 2     0.10453142         -0.27039311              -0.33716774
## 3     0.10267849          1.02076598               0.14095967
## 4     0.09897261         -0.01102572              -0.17910738
## 5     0.10193731          0.08810514              -0.04782845
## 6     0.09934320          1.85507756               0.83171075
##   Inv_diff_cooc.W.ADC Inv_diff_norm_cooc.W.ADC IDM_cooc.W.ADC
## 1          -0.1553491               -0.6079427    -0.03349743
## 2          -0.4606680               -0.5438010    -0.49096209
## 3          -0.3883356               -0.5742573    -0.37454564
## 4          -0.4560997               -0.5109719    -0.44995630
## 5          -0.5316046               -0.5551029    -0.51956613
## 6          -0.7241103               -0.6098508    -0.69179048
##   IDM_norm_cooc.W.ADC Inv_var_cooc.W.ADC Correlation_cooc.W.ADC
## 1          -0.5973520        -0.04727434            -0.70519175
## 2          -0.5502015        -0.51116122            -0.51902018
## 3          -0.5799243        -0.34876260             0.09406992
## 4          -0.5392978        -0.47829938             0.05818005
## 5          -0.5542619        -0.57573855            -0.52509677
## 6          -0.5872923        -0.70852330             0.19000410
##   Autocorrelation_cooc.W.ADC Tendency_cooc.W.ADC Shade_cooc.W.ADC
## 1                -0.82825568          -0.1239002      0.748492311
## 2                 0.40596504          -0.3998223     -0.849230344
## 3                -0.81538896           1.3894965      5.445020127
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## 4                 0.41742441           0.2845655     -0.006023108
## 5                -0.06977856          -0.1595859     -0.210118336
## 6                 0.94845945           2.5166759     -1.349842393
##   Prominence_cooc.W.ADC  IC1_d.W.ADC IC2_d.W.ADC Coarseness_vdif.W.ADC
## 1           -0.11542708 -0.903263171  -0.1907350            0.27382766
## 2           -0.35816223  0.001800882  -0.3183774            0.07761691
## 3            3.59414354 -0.093125575  -0.2756556           -0.04800583
## 4            0.08908301  0.541318048  -0.4760088           -0.10722798
## 5           -0.22271379 -0.075272999  -0.2837085            0.02976063
## 6            2.39969624 -1.208111301  -0.1245345            0.01689925
##   Contrast_vdif.W.ADC Busyness_vdif.W.ADC Complexity_vdif.W.ADC
## 1          2.05493666          -0.3772693           -0.6073412
## 2         -0.14928773          -0.5719455           -0.4755028
## 3          0.18526528          -0.1397398            0.4134439
## 4         -0.40258421          -0.3596382            0.1805608
## 5          0.00417449          -0.5038700           -0.2096065
## 6          0.99857484          -0.5979023            0.7943650
##   Strength_vdif.W.ADC SRE_align.W.ADC LRE_align.W.ADC GLNU_align.W.ADC
## 1           1.4669901      -0.5607394      -0.5636282       -0.6918875
## 2           0.3446350      -0.5544960      -0.5851724       -0.6123816
## 3           1.4197272      -0.5563057      -0.5759453       -0.5149668
## 4          -0.3174056      -0.5581606      -0.5711293       -0.3228389
## 5           0.3114865      -0.5550163      -0.5809744       -0.6154673
## 6           1.3787764      -0.5492932      -0.6052889       -0.6590509
##   RLNU_align.W.ADC RP_align.W.ADC LGRE_align.W.ADC HGRE_align.W.ADC
## 1       -0.6585680     -0.5598492      0.102514356      -0.72391839
## 2       -0.5705684     -0.5523782      0.011942997       0.31043574
## 3       -0.4530326     -0.5552168      0.016044342      -0.74102269
## 4       -0.1392104     -0.5572378      0.066969370       0.48049736
## 5       -0.5417353     -0.5534228      0.005790981      -0.02339079
## 6       -0.5222697     -0.5454068     -0.003095266       1.12446188
##   LGSRE_align.W.ADC HGSRE_align.W.ADC LGHRE_align.W.ADC HGLRE_align.W.ADC
## 1        0.10748791       -0.72254855       0.077168309       -0.72942321
## 2        0.01660389        0.31244050      -0.012162463        0.30239721
## 3        0.02037644       -0.73855319      -0.006809308       -0.74942271
## 4        0.06598993        0.48251611       0.075830020        0.47104532
## 5        0.01043064       -0.02076085      -0.018184762       -0.03187296
## 6        0.00117076        1.13430855      -0.026883639        1.08473714
##   GLNU_norm_align.W.ADC RLNU_norm_align.W.ADC GLVAR_align.W.ADC
## 1            0.11990386            -0.5601024      0.0390388995
## 2           -0.03442756            -0.5440640     -0.3518347261
## 3           -0.08728526            -0.5487189      1.0925597603
## 4           -0.16167757            -0.5538576      0.2872015907
## 5           -0.11012500            -0.5451701     -0.0005432957
## 6           -0.22269232            -0.5301456      2.1850902501
##   RLVAR_align.W.ADC Entropy_align.W.ADC SZSE.W.ADC LZSE.W.ADC LGLZE.W.ADC
## 1       -0.07189017          -0.4489178 -0.5288302 -0.6847176 0.113374483
## 2       -0.16482743          -0.5433374 -0.5737026 -0.6013426 0.022597678
## 3       -0.10788699          -0.5008749 -0.5217499 -0.4855176 0.026380045
## 4       -0.09381551          -0.3577119 -0.5381157 -0.6310472 0.053200465
## 5       -0.13472099          -0.4469533 -0.5472388 -0.5737353 0.016064499
## 6       -0.26889098          -0.2581106 -0.5320105 -0.6652514 0.006780508
##   HGLZE.W.ADC SZLGE.W.ADC SZHGE.W.ADC LZLGE.W.ADC LZHGE.W.ADC GLNU_area.W.ADC
## 1 -0.71989596  0.12431381 -0.70418503  0.01531010 -0.78023810      -0.6914700
```
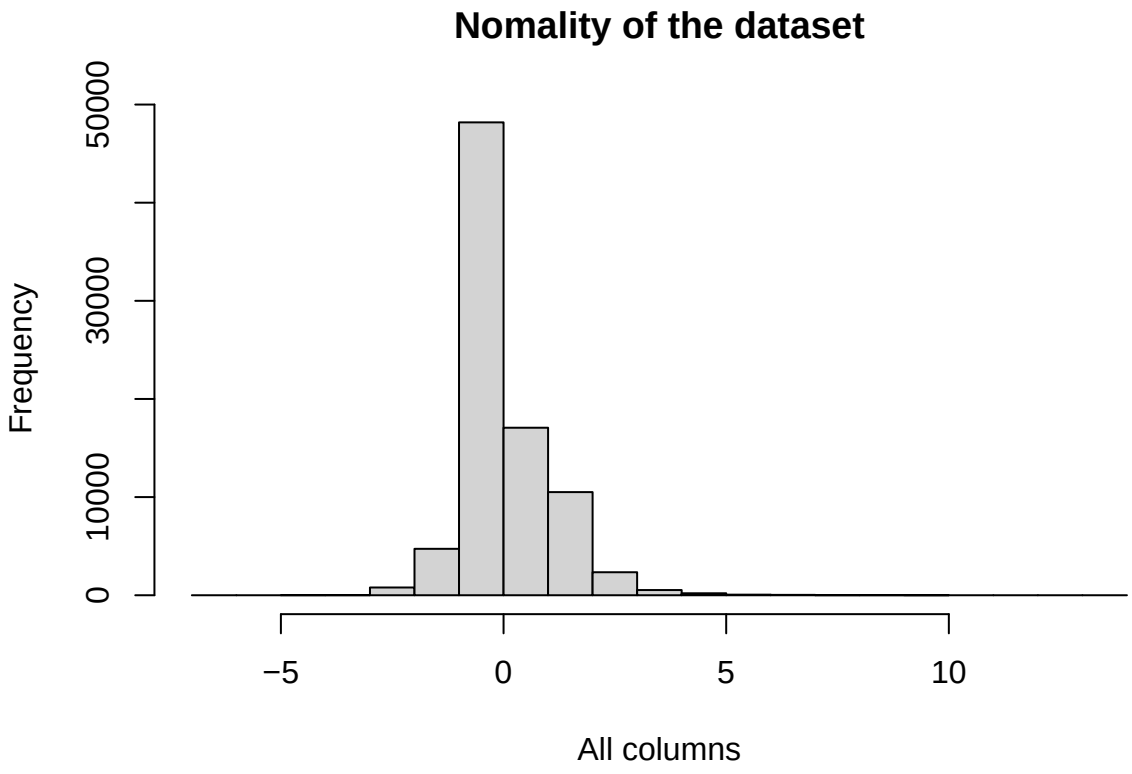

```
## 2  0.30739854  0.03294163  0.30621407 -0.06733775  0.29762888      -0.6100327
## 3 -0.74098507  0.03571049 -0.74294693 -0.05805147 -0.72852195      -0.5190294
## 4  0.47987855  0.04436315  0.49296111  0.07659951  0.42004184      -0.3130419
## 5 -0.03008663  0.02636560 -0.02934976 -0.07290951 -0.01111977      -0.6144844
## 6  1.11776106  0.01667461  1.13227954 -0.08157670  1.02554608      -0.6568667
##   ZSNU.W.ADC  ZSP.W.ADC GLNU_norm.W.ADC ZSNU_norm.W.ADC GLVAR_area.W.ADC
## 1 -0.6513787 -0.5068231      0.07698041      -0.4888097      0.040207659
## 2 -0.5660417 -0.5606797     -0.06244984      -0.5444800     -0.353463617
## 3 -0.4563908 -0.5221702      0.26861743      -0.5868989      1.070427270
## 4 -0.1207423 -0.5237049     -0.18723674      -0.5112910      0.284745010
## 5 -0.5366044 -0.5410354      0.27657578      -0.5328275      0.002215947
## 6 -0.5137505 -0.5128675     -0.24612851      -0.4964165      2.154394753
##   ZSVAR.W.ADC Entropy_area.W.ADC
## 1 -0.70463402         -0.7414506
## 2 -0.42606449         -0.5771180
## 3  0.09854219         -0.4508095
## 4 -0.48028511         -0.4046157
## 5 -0.23584790         -0.4859857
## 6 -0.62125871         -0.3202609
```

```
# check that we get mean of 0 and sd of 1 (Uncomment this if needed)
# colMeans(scaled_df)  # faster version of apply(scaled_df, 2, mean)
# apply(scaled_df, 2, sd)
```

```
#Check if the whole dataset is normalized
hist(scaled_df, xlab = 'All columns', main = paste("Nomality of the dataset"))
```



Get the correleation of the whole data except categorical variables

```
#Calculate correlation using base R
cor_radio_df <- round(cor(scaled_df),2)
head(data.frame(cor_radio_df))
```

```
##                     Failure Entropy_cooc.W.ADC GLNU_align.H.PET Min_hist.PET
## Failure                1.00              -0.35            -0.23        -0.12
## Entropy_cooc.W.ADC    -0.35               1.00             0.39         0.02
## GLNU_align.H.PET      -0.23               0.39             1.00        -0.03
## Min_hist.PET          -0.12               0.02            -0.03         1.00
## Max_hist.PET          -0.13               0.08             0.04         0.91
## Mean_hist.PET         -0.12               0.04            -0.02         0.98
##                     Max_hist.PET Mean_hist.PET Variance_hist.PET
## Failure                    -0.13         -0.12             -0.12
## Entropy_cooc.W.ADC          0.08          0.04              0.05
## GLNU_align.H.PET            0.04         -0.02              0.00
## Min_hist.PET                0.91          0.98              0.78
## Max_hist.PET                1.00          0.95              0.88
## Mean_hist.PET               0.95          1.00              0.85
##                     Standard_Deviation_hist.PET Skewness_hist.PET
## Failure                                   -0.11             -0.01
## Entropy_cooc.W.ADC                         0.05              0.03
## GLNU_align.H.PET                           0.00             -0.01
## Min_hist.PET                               0.90              0.14
## Max_hist.PET                               0.97              0.25
## Mean_hist.PET                              0.95              0.09
##                     Kurtosis_hist.PET Energy_hist.PET Entropy_hist.PET
## Failure                          0.02           0.06            -0.10
## Entropy_cooc.W.ADC               0.08          -0.04             0.14
## GLNU_align.H.PET                 0.07           0.00             0.08
## Min_hist.PET                    -0.04           0.09             0.56
## Max_hist.PET                     0.12           0.08             0.64
## Mean_hist.PET                   -0.07           0.08             0.58
##                     AUC_hist.PET H_suv.PET Volume.PET X3D_surface.PET
## Failure                     0.00     -0.05      -0.12           -0.15
## Entropy_cooc.W.ADC          0.04     -0.02       0.12            0.18
## GLNU_align.H.PET           -0.02     -0.06       0.12            0.37
## Min_hist.PET                0.51      0.86       0.37            0.25
## Max_hist.PET                0.53      0.87       0.50            0.39
## Mean_hist.PET               0.51      0.90       0.41            0.29
##                     ratio_3ds_vol.PET ratio_3ds_vol_norm.PET irregularity.PET
## Failure                          0.13                   0.05             0.03
## Entropy_cooc.W.ADC              -0.03                   0.13             0.00
## GLNU_align.H.PET                -0.09                   0.20            -0.11
## Min_hist.PET                     0.13                   0.20             0.47
## Max_hist.PET                     0.08                   0.32             0.45
## Mean_hist.PET                    0.09                   0.22             0.45
##                     tumor_length.PET Compactness_v1.PET Compactness_v2.PET
## Failure                        -0.11               0.00             -0.12
## Entropy_cooc.W.ADC              0.20              -0.07             -0.11
## GLNU_align.H.PET                0.31               0.00             -0.11
## Min_hist.PET                    0.40               0.24              0.33
```

```
## Max_hist.PET                  0.57              0.27              0.35
## Mean_hist.PET                 0.45              0.25              0.35
##                     Spherical_disproportion.PET Sphericity.PET Asphericity.PET
## Failure                                    0.05         -0.11            0.05
## Entropy_cooc.W.ADC                         0.13         -0.10            0.13
## GLNU_align.H.PET                           0.20         -0.14            0.20
## Min_hist.PET                               0.20          0.32            0.19
## Max_hist.PET                               0.32          0.33            0.30
## Mean_hist.PET                              0.22          0.34            0.20
##                     Center_of_mass.PET Max_3D_diam.PET Major_axis_length.PET
## Failure                          -0.13          -0.16                -0.15
## Entropy_cooc.W.ADC                0.17           0.09                 0.11
## GLNU_align.H.PET                  0.22           0.12                 0.15
## Min_hist.PET                      0.25           0.51                 0.56
## Max_hist.PET                      0.47           0.65                 0.70
## Mean_hist.PET                     0.31           0.56                 0.61
##                     Minor_axis_length.PET Least_axis_length.PET Elongation.PET
## Failure                             -0.13                -0.15           0.02
## Entropy_cooc.W.ADC                   0.17                 0.16           0.06
## GLNU_align.H.PET                     0.26                 0.25           0.03
## Min_hist.PET                         0.47                 0.47           0.33
## Max_hist.PET                         0.65                 0.64           0.33
## Mean_hist.PET                        0.52                 0.53           0.32
##                     Flatness.PET Max_cooc.L.PET Average_cooc.L.PET
## Failure                     0.00           0.06               0.08
## Entropy_cooc.W.ADC          0.07          -0.02              -0.05
## GLNU_align.H.PET            0.06           0.04              -0.15
## Min_hist.PET                0.36           0.10               0.44
## Max_hist.PET                0.37           0.13               0.33
## Mean_hist.PET               0.36           0.10               0.45
##                     Variance_cooc.L.PET Entropy_cooc.L.PET DAVE_cooc.L.PET
## Failure                            0.12               0.00            0.10
## Entropy_cooc.W.ADC                -0.16               0.02           -0.15
## GLNU_align.H.PET                  -0.24              -0.04           -0.23
## Min_hist.PET                       0.30               0.56            0.42
## Max_hist.PET                       0.11               0.55            0.24
## Mean_hist.PET                      0.25               0.57            0.38
##                     DVAR_cooc.L.PET DENT_cooc.L.PET SAVE_cooc.L.PET
## Failure                        0.14            0.03            0.08
## Entropy_cooc.W.ADC            -0.18           -0.03           -0.05
## GLNU_align.H.PET              -0.19           -0.12           -0.15
## Min_hist.PET                   0.39            0.53            0.44
## Max_hist.PET                   0.27            0.48            0.33
## Mean_hist.PET                  0.34            0.52            0.45
##                     SVAR_cooc.L.PET SENT_cooc.L.PET ASM_cooc.L.PET
## Failure                        0.11            0.03           0.05
## Entropy_cooc.W.ADC            -0.12            0.03          -0.02
## GLNU_align.H.PET              -0.20           -0.05           0.05
## Min_hist.PET                   0.27            0.50           0.10
## Max_hist.PET                   0.10            0.47           0.12
## Mean_hist.PET                  0.23            0.49           0.10
##                     Contrast_cooc.L.PET Dissimilarity_cooc.L.PET
## Failure                            0.13                    0.10
## Entropy_cooc.W.ADC                -0.20                   -0.15
```

```
## GLNU_align.H.PET                -0.26                    -0.23
## Min_hist.PET                     0.31                     0.42
## Max_hist.PET                     0.10                     0.24
## Mean_hist.PET                    0.26                     0.38
##                    Inv_diff_cooc.L.PET Inv_diff_norm_cooc.L.PET IDM_cooc.L.PET
## Failure                         -0.06                    -0.01          -0.07
## Entropy_cooc.W.ADC               0.13                     0.05           0.14
## GLNU_align.H.PET                 0.13                    -0.01           0.17
## Min_hist.PET                     0.42                     0.53           0.35
## Max_hist.PET                     0.58                     0.57           0.54
## Mean_hist.PET                    0.44                     0.53           0.38
##                    IDM_norm_cooc.L.PET Inv_var_cooc.L.PET
## Failure                         -0.01              -0.06
## Entropy_cooc.W.ADC               0.04               0.14
## GLNU_align.H.PET                -0.02               0.16
## Min_hist.PET                     0.53               0.35
## Max_hist.PET                     0.56               0.55
## Mean_hist.PET                    0.53               0.38
##                    Correlation_cooc.L.PET Autocorrelation_cooc.L.PET
## Failure                             -0.08                       0.13
## Entropy_cooc.W.ADC                   0.19                      -0.07
## GLNU_align.H.PET                     0.17                      -0.17
## Min_hist.PET                         0.24                       0.28
## Max_hist.PET                         0.39                       0.14
## Mean_hist.PET                        0.28                       0.30
##                    Tendency_cooc.L.PET Shade_cooc.L.PET Prominence_cooc.L.PET
## Failure                           0.11            -0.02                  0.13
## Entropy_cooc.W.ADC               -0.12            -0.06                 -0.15
## GLNU_align.H.PET                 -0.20            -0.13                 -0.23
## Min_hist.PET                      0.27             0.12                  0.13
## Max_hist.PET                      0.10             0.08                 -0.04
## Mean_hist.PET                     0.23             0.05                  0.07
##                    IC1_.L.PET IC2_.L.PET Coarseness_vdif_.L.PET
## Failure                 -0.08       0.05                   0.09
## Entropy_cooc.W.ADC       0.08      -0.03                  -0.06
## GLNU_align.H.PET         0.25      -0.12                  -0.08
## Min_hist.PET            -0.06       0.38                   0.07
## Max_hist.PET             0.06       0.34                   0.02
## Mean_hist.PET           -0.01       0.36                   0.04
##                    Contrast_vdif_.L.PET Busyness_vdif_.L.PET
## Failure                            0.07                -0.18
## Entropy_cooc.W.ADC                -0.12                 0.13
## GLNU_align.H.PET                  -0.21                 0.26
## Min_hist.PET                       0.10                 0.32
## Max_hist.PET                      -0.06                 0.50
## Mean_hist.PET                      0.03                 0.36
##                    Complexity_vdif_.L.PET Strength_vdif_.L.PET SRE_align.L.PET
## Failure                              0.09                 0.11           0.01
## Entropy_cooc.W.ADC                  -0.14                -0.12           0.02
## GLNU_align.H.PET                    -0.20                -0.27          -0.05
## Min_hist.PET                         0.41                 0.01           0.53
## Max_hist.PET                         0.25                -0.13           0.54
## Mean_hist.PET                        0.35                -0.08           0.53
##                    LRE_align.L.PET GLNU_align.L.PET RLNU_align.L.PET
```

```
## Failure                    -0.02           -0.17           -0.20
## Entropy_cooc.W.ADC          0.05            0.16            0.15
## GLNU_align.H.PET            0.00            0.30            0.29
## Min_hist.PET                0.52            0.30            0.34
## Max_hist.PET                0.57            0.51            0.50
## Mean_hist.PET               0.53            0.35            0.39
##                   RP_align.L.PET LGRE_align.L.PET HGRE_align.L.PET
## Failure                     0.01            0.01            0.11
## Entropy_cooc.W.ADC          0.02           -0.03           -0.07
## GLNU_align.H.PET           -0.05            0.02           -0.17
## Min_hist.PET                0.53            0.26            0.31
## Max_hist.PET                0.54            0.30            0.16
## Mean_hist.PET               0.53            0.20            0.33
##                   LGSRE_align.L.PET HGSRE_align.L.PET LGHRE_align.L.PET
## Failure                        0.01              0.12              0.00
## Entropy_cooc.W.ADC            -0.03             -0.07             -0.02
## GLNU_align.H.PET               0.02             -0.18              0.03
## Min_hist.PET                   0.27              0.31              0.24
## Max_hist.PET                   0.30              0.16              0.30
## Mean_hist.PET                  0.21              0.32              0.19
##                   HGLRE_align.L.PET GLNU_norm_align.L.PET
## Failure                        0.10                  0.04
## Entropy_cooc.W.ADC            -0.06                  0.00
## GLNU_align.H.PET              -0.15                  0.03
## Min_hist.PET                   0.32                  0.23
## Max_hist.PET                   0.18                  0.29
## Mean_hist.PET                  0.34                  0.21
##                   RLNU_norm_align.L.PET GLVAR_align.L.PET RLVAR_align.L.PET
## Failure                            0.01              0.12             -0.03
## Entropy_cooc.W.ADC                 0.01             -0.13              0.10
## GLNU_align.H.PET                  -0.06             -0.21              0.18
## Min_hist.PET                       0.53              0.33              0.25
## Max_hist.PET                       0.52              0.14              0.42
## Mean_hist.PET                      0.53              0.29              0.28
##                   Entropy_align.L.PET SZSE.L.PET LZSE.L.PET LGLZE.L.PET
## Failure                          0.00       0.03      -0.10        0.01
## Entropy_cooc.W.ADC               0.03       0.00       0.12       -0.02
## GLNU_align.H.PET                -0.04      -0.09       0.16        0.02
## Min_hist.PET                     0.55       0.53       0.33        0.27
## Max_hist.PET                     0.55       0.52       0.45        0.31
## Mean_hist.PET                    0.56       0.52       0.36        0.21
##                   HGLZE.L.PET SZLGE.L.PET SZHGE.L.PET LZLGE.L.PET LZHGE.L.PET
## Failure                  0.11        0.02        0.12       -0.03        0.03
## Entropy_cooc.W.ADC      -0.07       -0.03       -0.09        0.02        0.00
## GLNU_align.H.PET        -0.18        0.00       -0.20        0.11       -0.02
## Min_hist.PET             0.32        0.28        0.33        0.17        0.25
## Max_hist.PET             0.17        0.30        0.17        0.29        0.16
## Mean_hist.PET            0.33        0.22        0.33        0.13        0.28
##                   GLNU_area.L.PET ZSNU.L.PET ZSP.L.PET GLNU_norm.L.PET
## Failure                     -0.17      -0.19      0.03            0.04
## Entropy_cooc.W.ADC           0.15       0.14      0.00            0.00
## GLNU_align.H.PET             0.29       0.28     -0.09            0.03
## Min_hist.PET                 0.31       0.35      0.53            0.23
## Max_hist.PET                 0.51       0.50      0.51            0.29
```

```
## Mean_hist.PET                0.35       0.40      0.52            0.21
##                     ZSNU_norm.L.PET GLVAR_area.L.PET ZSVAR.L.PET
## Failure                        0.02             0.12       -0.09
## Entropy_cooc.W.ADC             0.00            -0.13        0.16
## GLNU_align.H.PET              -0.09            -0.22        0.25
## Min_hist.PET                   0.53             0.34        0.18
## Max_hist.PET                   0.49             0.15        0.43
## Mean_hist.PET                  0.52             0.30        0.23
##                     Entropy_area.L.PET Max_cooc.H.PET Average_cooc.H.PET
## Failure                          -0.01           0.10               0.04
## Entropy_cooc.W.ADC                0.04          -0.04               0.00
## GLNU_align.H.PET                 -0.02          -0.03              -0.07
## Min_hist.PET                      0.55          -0.34               0.39
## Max_hist.PET                      0.57          -0.37               0.38
## Mean_hist.PET                     0.57          -0.38               0.37
##                     Variance_cooc.H.PET Entropy_cooc.H.PET DAVE_cooc.H.PET
## Failure                           -0.04              -0.01            0.02
## Entropy_cooc.W.ADC                 0.05              -0.07           -0.03
## GLNU_align.H.PET                  -0.01              -0.10           -0.11
## Min_hist.PET                       0.73               0.70            0.69
## Max_hist.PET                       0.76               0.72            0.65
## Mean_hist.PET                      0.77               0.71            0.69
##                     DVAR_cooc.H.PET DENT_cooc.H.PET SAVE_cooc.H.PET
## Failure                        0.04           -0.11            0.01
## Entropy_cooc.W.ADC            -0.03            0.18            0.04
## GLNU_align.H.PET              -0.10            0.09           -0.05
## Min_hist.PET                   0.62            0.61            0.45
## Max_hist.PET                   0.58            0.62            0.45
## Mean_hist.PET                  0.63            0.61            0.44
##                     SVAR_cooc.H.PET SENT_cooc.H.PET ASM_cooc.H.PET
## Failure                       -0.08            0.01           0.12
## Entropy_cooc.W.ADC             0.18            0.09          -0.05
## GLNU_align.H.PET               0.08            0.06          -0.01
## Min_hist.PET                   0.66            0.61          -0.32
## Max_hist.PET                   0.70            0.63          -0.33
## Mean_hist.PET                  0.69            0.63          -0.35
##                     Contrast_cooc.H.PET Dissimilarity_cooc.H.PET
## Failure                            0.04                    0.02
## Entropy_cooc.W.ADC                -0.06                   -0.03
## GLNU_align.H.PET                  -0.12                   -0.11
## Min_hist.PET                       0.67                    0.69
## Max_hist.PET                       0.61                    0.65
## Mean_hist.PET                      0.68                    0.69
##                     Inv_diff_cooc.H.PET Inv_diff_norm_cooc.H.PET IDM_cooc.H.PET
## Failure                            0.06                    0.00           0.07
## Entropy_cooc.W.ADC                 0.04                    0.04           0.04
## GLNU_align.H.PET                   0.03                   -0.03           0.03
## Min_hist.PET                      -0.12                    0.49          -0.23
## Max_hist.PET                      -0.08                    0.51          -0.21
## Mean_hist.PET                     -0.13                    0.49          -0.26
##                     IDM_norm_cooc.H.PET Inv_var_cooc_.H.PET
## Failure                            0.00               -0.01
## Entropy_cooc.W.ADC                 0.03                0.03
## GLNU_align.H.PET                  -0.03                0.06
```

```
## Min_hist.PET                      0.51               0.43
## Max_hist.PET                      0.53               0.50
## Mean_hist.PET                     0.51               0.44
##                    Correlation_cooc.H.PET Autocorrelation_cooc.H.PET
## Failure                             -0.10                       0.07
## Entropy_cooc.W.ADC                   0.19                      -0.01
## GLNU_align.H.PET                     0.17                      -0.07
## Min_hist.PET                         0.31                       0.25
## Max_hist.PET                         0.46                       0.24
## Mean_hist.PET                        0.35                       0.23
##                    Tendency_cooc.H.PET Shade_cooc.H.PET Prominence_cooc.H.PET
## Failure                          -0.07           -0.01                 -0.10
## Entropy_cooc.W.ADC                0.11           -0.06                  0.12
## GLNU_align.H.PET                  0.05           -0.01                  0.09
## Min_hist.PET                      0.69           -0.37                  0.71
## Max_hist.PET                      0.77           -0.41                  0.81
## Mean_hist.PET                     0.75           -0.44                  0.79
##                    IC1_d.H.PET IC2_d.H.PET Coarseness_vdif.H.PET
## Failure                   0.09       -0.09                  0.06
## Entropy_cooc.W.ADC       -0.18        0.15                 -0.04
## GLNU_align.H.PET         -0.15        0.11                  0.03
## Min_hist.PET              0.13        0.43                  0.11
## Max_hist.PET              0.01        0.56                  0.11
## Mean_hist.PET             0.10        0.47                  0.10
##                    Contrast_vdif.H.PET Busyness_vdif.H.PET
## Failure                           0.16               -0.11
## Entropy_cooc.W.ADC               -0.02               -0.05
## GLNU_align.H.PET                 -0.10               -0.06
## Min_hist.PET                     -0.28                0.09
## Max_hist.PET                     -0.33                0.15
## Mean_hist.PET                    -0.29                0.10
##                    Complexity_vdif.H.PET Strength_vdif.H.PET SRE_align.H.PET
## Failure                             0.11                0.13           -0.01
## Entropy_cooc.W.ADC                  0.02               -0.18            0.01
## GLNU_align.H.PET                   -0.02               -0.09           -0.06
## Min_hist.PET                        0.37               -0.10            0.66
## Max_hist.PET                        0.30               -0.14            0.67
## Mean_hist.PET                       0.35               -0.12            0.67
##                    LRE_align.H.PET RLNU_align.H.PET RP_align.H.PET
## Failure                       0.02            -0.19          -0.01
## Entropy_cooc.W.ADC            0.10             0.14           0.00
## GLNU_align.H.PET              0.04             0.28          -0.07
## Min_hist.PET                 -0.09             0.41           0.69
## Max_hist.PET                 -0.05             0.57           0.69
## Mean_hist.PET                -0.10             0.47           0.69
##                    LGRE_align.H.PET HGRE_align.H.PET LGSRE_align.H.PET
## Failure                        0.04             0.04              0.05
## Entropy_cooc.W.ADC            -0.02             0.00             -0.02
## GLNU_align.H.PET               0.05            -0.07              0.05
## Min_hist.PET                   0.16             0.27              0.16
## Max_hist.PET                   0.18             0.27              0.18
## Mean_hist.PET                  0.17             0.25              0.17
##                    HGSRE_align.H.PET LGHRE_align.H.PET HGLRE_align.H.PET
## Failure                         0.02              0.04              0.09
```

```
## Entropy_cooc.W.ADC            -0.01             -0.01              0.05
## GLNU_align.H.PET              -0.10              0.06              0.06
## Min_hist.PET                   0.46              0.16             -0.25
## Max_hist.PET                   0.44              0.19             -0.23
## Mean_hist.PET                  0.43              0.17             -0.26
##                    GLNU_norm_align.H.PET RLNU_norm_align.H.PET
## Failure                             0.12                 -0.02
## Entropy_cooc.W.ADC                 -0.04                 -0.01
## GLNU_align.H.PET                   -0.06                 -0.08
## Min_hist.PET                       -0.27                  0.76
## Max_hist.PET                       -0.30                  0.75
## Mean_hist.PET                      -0.32                  0.76
##                    GLVAR_align.H.PET RLVAR_align.H.PET Entropy_align.H.PET
## Failure                        -0.04              0.04               -0.07
## Entropy_cooc.W.ADC              0.06              0.10                0.08
## GLNU_align.H.PET                0.00              0.15                0.02
## Min_hist.PET                    0.73             -0.38                0.75
## Max_hist.PET                    0.77             -0.33                0.81
## Mean_hist.PET                   0.78             -0.38                0.79
##                    SZSE.H.PET LZSE.H.PET LGLZE.H.PET HGLZE.H.PET SZLGE.H.PET
## Failure                 -0.03      -0.05        0.05        0.00        0.05
## Entropy_cooc.W.ADC       0.00       0.15       -0.02        0.07       -0.02
## GLNU_align.H.PET        -0.08       0.10        0.05        0.00        0.05
## Min_hist.PET             0.78      -0.22        0.16        0.28        0.16
## Max_hist.PET             0.79      -0.21        0.19        0.32        0.18
## Mean_hist.PET            0.79      -0.22        0.17        0.26        0.16
##                    SZHGE.H.PET LZLGE.H.PET LZHGE.H.PET GLNU_area.H.PET
## Failure                  -0.03       -0.05        0.00           -0.18
## Entropy_cooc.W.ADC       -0.02        0.17        0.09            0.12
## GLNU_align.H.PET         -0.12        0.17        0.09            0.25
## Min_hist.PET              0.61       -0.26       -0.27            0.30
## Max_hist.PET              0.60       -0.23       -0.26            0.46
## Mean_hist.PET             0.58       -0.25       -0.26            0.34
##                    ZSNU.H.PET ZSP.H.PET GLNU_norm.H.PET ZSNU_norm.H.PET
## Failure                 -0.17     -0.05            0.13           -0.06
## Entropy_cooc.W.ADC       0.12     -0.03           -0.03           -0.01
## GLNU_align.H.PET         0.24     -0.10           -0.06           -0.07
## Min_hist.PET             0.49      0.86           -0.27            0.85
## Max_hist.PET             0.62      0.85           -0.30            0.85
## Mean_hist.PET            0.55      0.87           -0.31            0.87
##                    GLVAR_area.H.PET ZSVAR_H.PET Entropy_area.H.PET
## Failure                       -0.04       -0.04              -0.05
## Entropy_cooc.W.ADC             0.07        0.14               0.08
## GLNU_align.H.PET              -0.01        0.11               0.03
## Min_hist.PET                   0.72       -0.25               0.63
## Max_hist.PET                   0.77       -0.24               0.70
## Mean_hist.PET                  0.77       -0.25               0.66
##                    Max_cooc.W.PET Average_cooc.W.PET Variance_cooc.W.PET
## Failure                      0.11             -0.10               -0.11
## Entropy_cooc.W.ADC          -0.07              0.05                0.04
## GLNU_align.H.PET            -0.01             -0.01               -0.01
## Min_hist.PET                -0.23              0.89                0.77
## Max_hist.PET                -0.25              0.95                0.86
## Mean_hist.PET               -0.26              0.96                0.83
```

```
##                     Entropy_cooc.W.PET DAVE_cooc.W.PET DVAR_cooc.W.PET
## Failure                          -0.07           -0.07           -0.08
## Entropy_cooc.W.ADC                0.04           -0.03           -0.03
## GLNU_align.H.PET                 -0.02           -0.08           -0.07
## Min_hist.PET                      0.82            0.91            0.82
## Max_hist.PET                      0.86            0.91            0.86
## Mean_hist.PET                     0.85            0.94            0.86
##                     DENT_cooc.W.PET SAVE_cooc.W.PET SVAR_cooc.W.PET
## Failure                       -0.05           -0.10           -0.12
## Entropy_cooc.W.ADC             0.01            0.05            0.07
## GLNU_align.H.PET              -0.06           -0.01            0.02
## Min_hist.PET                   0.84            0.89            0.72
## Max_hist.PET                   0.85            0.95            0.84
## Mean_hist.PET                  0.86            0.96            0.78
##                     SENT_cooc.W.PET ASM_cooc.W.PET Contrast_cooc.W.PET
## Failure                       -0.05           0.11               -0.08
## Entropy_cooc.W.ADC             0.06          -0.06               -0.04
## GLNU_align.H.PET               0.00           0.01               -0.08
## Min_hist.PET                   0.76          -0.15                0.84
## Max_hist.PET                   0.80          -0.15                0.85
## Mean_hist.PET                  0.78          -0.17                0.88
##                     Dissimilarity_cooc.W.PET Inv_diff_cooc.W.PET
## Failure                            -0.07                0.06
## Entropy_cooc.W.ADC                 -0.03                0.04
## GLNU_align.H.PET                   -0.08                0.01
## Min_hist.PET                        0.91               -0.06
## Max_hist.PET                        0.91               -0.04
## Mean_hist.PET                       0.94               -0.08
##                     Inv_diff_norm_cooc.W.PET IDM_cooc.W.PET IDM_norm_cooc.W.PET
## Failure                            -0.01           0.07               -0.01
## Entropy_cooc.W.ADC                  0.05           0.04                0.04
## GLNU_align.H.PET                   -0.01           0.02               -0.02
## Min_hist.PET                        0.52          -0.21                0.53
## Max_hist.PET                        0.57          -0.19                0.56
## Mean_hist.PET                       0.53          -0.24                0.53
##                     Inv_var_cooc.W.PET Correlation_cooc.W.PET
## Failure                           0.07                -0.08
## Entropy_cooc.W.ADC                0.05                 0.19
## GLNU_align.H.PET                  0.01                 0.17
## Min_hist.PET                     -0.15                 0.25
## Max_hist.PET                     -0.12                 0.41
## Mean_hist.PET                    -0.17                 0.29
##                     Autocorrelation_cooc.W.PET Tendency_cooc.W.PET
## Failure                              -0.11              -0.12
## Entropy_cooc.W.ADC                    0.07               0.07
## GLNU_align.H.PET                      0.01               0.02
## Min_hist.PET                          0.80               0.72
## Max_hist.PET                          0.88               0.84
## Mean_hist.PET                         0.88               0.78
##                     Shade_cooc.W.PET Prominence_cooc.W.PET IC1_d.W.PET
## Failure                       -0.08                -0.08        0.08
## Entropy_cooc.W.ADC             0.06                 0.07       -0.14
## GLNU_align.H.PET               0.03                 0.03       -0.07
## Min_hist.PET                   0.28                 0.28        0.00
```

```
## Max_hist.PET                  0.46                  0.46       -0.09
## Mean_hist.PET                 0.33                  0.34       -0.02
##                     IC2_d.W.PET Coarseness_vdif.W.PET Contrast_vdif.W.PET
## Failure                   -0.06                  0.10                0.01
## Entropy_cooc.W.ADC         0.10                 -0.07               -0.13
## GLNU_align.H.PET           0.04                 -0.11               -0.18
## Min_hist.PET               0.51                  0.04                0.78
## Max_hist.PET               0.61                 -0.03                0.66
## Mean_hist.PET              0.54                  0.01                0.76
##                     Busyness_vdif.W.PET Complexity_vdif.W.PET
## Failure                           -0.02                -0.11
## Entropy_cooc.W.ADC                 0.01                 0.07
## GLNU_align.H.PET                   0.10                 0.04
## Min_hist.PET                      -0.33                 0.61
## Max_hist.PET                      -0.32                 0.79
## Mean_hist.PET                     -0.35                 0.68
##                     Strength_vdif.W.PET SRE_align.W.PET LRE_align.W.PET
## Failure                            0.01           0.00            0.02
## Entropy_cooc.W.ADC                -0.03           0.02            0.06
## GLNU_align.H.PET                  -0.14          -0.05            0.03
## Min_hist.PET                       0.46           0.60            0.17
## Max_hist.PET                       0.46           0.61            0.20
## Mean_hist.PET                      0.42           0.60            0.17
##                     GLNU_align.W.PET RLNU_align.W.PET RP_align.W.PET
## Failure                        -0.17           -0.19          -0.01
## Entropy_cooc.W.ADC              0.15            0.15           0.02
## GLNU_align.H.PET                0.30            0.29          -0.06
## Min_hist.PET                    0.10            0.38           0.62
## Max_hist.PET                    0.28            0.54           0.63
## Mean_hist.PET                   0.14            0.44           0.62
##                     LGRE_align.W.PET HGRE_align.W.PET LGSRE_align.W.PET
## Failure                         0.10           -0.12             0.09
## Entropy_cooc.W.ADC             -0.06            0.07            -0.07
## GLNU_align.H.PET               -0.06            0.00            -0.07
## Min_hist.PET                   -0.22            0.80            -0.18
## Max_hist.PET                   -0.27            0.88            -0.23
## Mean_hist.PET                  -0.29            0.88            -0.26
##                     HGSRE_align.W.PET LGHRE_align.W.PET HGLRE_align.W.PET
## Failure                         -0.11             0.09            -0.12
## Entropy_cooc.W.ADC               0.06            -0.04             0.08
## GLNU_align.H.PET                 0.00            -0.02             0.02
## Min_hist.PET                     0.80            -0.33             0.79
## Max_hist.PET                     0.88            -0.36             0.88
## Mean_hist.PET                    0.88            -0.39             0.88
##                     GLNU_norm_align.W.PET RLNU_norm_align.W.PET
## Failure                              0.12                -0.01
## Entropy_cooc.W.ADC                  -0.05                 0.01
## GLNU_align.H.PET                    -0.06                -0.06
## Min_hist.PET                        -0.24                 0.67
## Max_hist.PET                        -0.27                 0.68
## Mean_hist.PET                       -0.29                 0.68
##                     GLVAR_align.W.PET RLVAR_align.W.PET Entropy_align.W.PET
## Failure                         -0.12             0.06               -0.07
## Entropy_cooc.W.ADC               0.05             0.08                0.07
```

```
## GLNU_align.H.PET               0.00              0.12               0.01
## Min_hist.PET                   0.78             -0.35               0.76
## Max_hist.PET                   0.88             -0.30               0.82
## Mean_hist.PET                  0.84             -0.36               0.80
##                    SZSE.W.PET LZSE.W.PET LGLZE.W.PET HGLZE.W.PET SZLGE.W.PET
## Failure                 -0.01       0.04        0.10       -0.12        0.09
## Entropy_cooc.W.ADC       0.00       0.07       -0.04        0.06       -0.04
## GLNU_align.H.PET        -0.08       0.11       -0.04        0.00       -0.06
## Min_hist.PET             0.69      -0.35       -0.22        0.80       -0.11
## Max_hist.PET             0.69      -0.34       -0.26        0.89       -0.16
## Mean_hist.PET            0.69      -0.36       -0.29        0.88       -0.18
##                    SZHGE.W.PET LZLGE.W.PET LZHGE.W.PET GLNU_area.W.PET
## Failure                 -0.11        0.03       -0.15           -0.17
## Entropy_cooc.W.ADC       0.05        0.01        0.14            0.14
## GLNU_align.H.PET        -0.01        0.03        0.17            0.27
## Min_hist.PET             0.80       -0.30        0.55            0.19
## Max_hist.PET             0.88       -0.30        0.66            0.37
## Mean_hist.PET            0.87       -0.31        0.64            0.23
##                    ZSNU.W.PET ZSP.W.PET GLNU_norm.W.PET ZSNU_norm.W.PET
## Failure                 -0.18     -0.03            0.12           -0.05
## Entropy_cooc.W.ADC       0.14      0.00           -0.03            0.00
## GLNU_align.H.PET         0.26     -0.09           -0.05           -0.07
## Min_hist.PET             0.44      0.78           -0.24            0.79
## Max_hist.PET             0.58      0.78           -0.27            0.79
## Mean_hist.PET            0.49      0.79           -0.28            0.80
##                    GLVAR_area.W.PET ZSVAR.W.PET Entropy_area.W.PET Min_hist.ADC
## Failure                       -0.12        0.03              -0.05         0.28
## Entropy_cooc.W.ADC             0.06        0.08               0.07        -0.20
## GLNU_align.H.PET               0.00        0.10               0.02        -0.23
## Min_hist.PET                   0.78       -0.36               0.68         0.17
## Max_hist.PET                   0.88       -0.35               0.74         0.11
## Mean_hist.PET                  0.84       -0.36               0.71         0.16
##                    Max_hist.ADC Mean_hist.ADC Variance_hist.ADC
## Failure                   -0.06          0.03             -0.10
## Entropy_cooc.W.ADC         0.18          0.02              0.29
## GLNU_align.H.PET           0.06         -0.09              0.15
## Min_hist.PET               0.46          0.44              0.19
## Max_hist.PET               0.52          0.44              0.25
## Mean_hist.PET              0.46          0.42              0.19
##                    Standard_Deviation_hist.ADC Skewness_hist.ADC
## Failure                                -0.08             0.13
## Entropy_cooc.W.ADC                      0.22            -0.03
## GLNU_align.H.PET                        0.08             0.00
## Min_hist.PET                            0.35             0.14
## Max_hist.PET                            0.41             0.21
## Mean_hist.PET                           0.35             0.19
##                    Kurtosis_hist.ADC Energy_hist.ADC Entropy_hist.ADC
## Failure                        -0.05           0.08           -0.09
## Entropy_cooc.W.ADC              0.02          -0.06            0.16
## GLNU_align.H.PET               -0.01           0.03            0.05
## Min_hist.PET                    0.17           0.10            0.56
## Max_hist.PET                    0.23           0.11            0.59
## Mean_hist.PET                   0.19           0.10            0.56
##                    AUC_hist.ADC Volume.ADC X3D_surface.ADC ratio_3ds_vol.ADC
```

```
## Failure                    0.00      -0.13           -0.20              0.21
## Entropy_cooc.W.ADC         0.03       0.10            0.26             -0.23
## GLNU_align.H.PET          -0.03       0.11            0.22             -0.23
## Min_hist.PET               0.53       0.35            0.28              0.24
## Max_hist.PET               0.56       0.47            0.39              0.19
## Mean_hist.PET              0.54       0.39            0.32              0.22
##                    ratio_3ds_vol_norm.ADC irregularity.ADC Compactness_v1.ADC
## Failure                         -0.05            0.08               0.07
## Entropy_cooc.W.ADC               0.07           -0.06              -0.04
## GLNU_align.H.PET                -0.03           -0.10               0.02
## Min_hist.PET                     0.51            0.49               0.26
## Max_hist.PET                     0.55            0.49               0.27
## Mean_hist.PET                    0.51            0.49               0.26
##                    Compactness_v2.ADC Spherical_disproportion.ADC
## Failure                          0.13                      -0.05
## Entropy_cooc.W.ADC              -0.12                       0.07
## GLNU_align.H.PET                -0.05                      -0.03
## Min_hist.PET                     0.35                       0.51
## Max_hist.PET                     0.32                       0.55
## Mean_hist.PET                    0.35                       0.51
##                    Sphericity.ADC Asphericity.ADC Center_of_mass.ADC
## Failure                      0.05           -0.11              -0.16
## Entropy_cooc.W.ADC          -0.03            0.11               0.21
## GLNU_align.H.PET            -0.05           -0.01               0.15
## Min_hist.PET                 0.49            0.38               0.11
## Max_hist.PET                 0.48            0.44               0.21
## Mean_hist.PET                0.49            0.38               0.13
##                    Max_3D_diam.ADC Major_axis_length.ADC Minor_axis_length.ADC
## Failure                      -0.20                -0.16                -0.19
## Entropy_cooc.W.ADC            0.27                 0.27                 0.25
## GLNU_align.H.PET              0.19                 0.17                 0.20
## Min_hist.PET                  0.41                 0.48                 0.39
## Max_hist.PET                  0.49                 0.56                 0.48
## Mean_hist.PET                 0.44                 0.50                 0.41
##                    Least_axis_length.ADC Elongation.ADC Flatness.ADC
## Failure                          -0.20          -0.08        -0.09
## Entropy_cooc.W.ADC                0.24           0.06         0.07
## GLNU_align.H.PET                  0.20           0.04         0.07
## Min_hist.PET                      0.39           0.41         0.41
## Max_hist.PET                      0.47           0.44         0.44
## Mean_hist.PET                     0.43           0.41         0.43
##                    Max_cooc.L.ADC Average_cooc.L.ADC Variance_cooc.L.ADC
## Failure                      0.04              -0.06                0.23
## Entropy_cooc.W.ADC          -0.01               0.00               -0.09
## GLNU_align.H.PET             0.05              -0.08               -0.17
## Min_hist.PET                 0.15               0.47                0.25
## Max_hist.PET                 0.19               0.45                0.21
## Mean_hist.PET                0.15               0.44                0.23
##                    Entropy_cooc.L.ADC DAVE_cooc.L.ADC DVAR_cooc.L.ADC
## Failure                          0.00            0.16            0.24
## Entropy_cooc.W.ADC               0.04           -0.10           -0.11
## GLNU_align.H.PET                -0.06           -0.17           -0.20
## Min_hist.PET                     0.54            0.40            0.25
## Max_hist.PET                     0.55            0.35            0.19
```

```
## Mean_hist.PET                  0.54            0.39            0.24
##                     DENT_cooc.L.ADC SAVE_cooc.L.ADC SVAR_cooc.L.ADC
## Failure                        0.05           -0.06            0.21
## Entropy_cooc.W.ADC            -0.01            0.00           -0.07
## GLNU_align.H.PET              -0.10           -0.08           -0.14
## Min_hist.PET                   0.52            0.47            0.24
## Max_hist.PET                   0.51            0.45            0.20
## Mean_hist.PET                  0.51            0.44            0.22
##                     SENT_cooc.L.ADC ASM_cooc.L.ADC Contrast_cooc.L.ADC
## Failure                        0.07           0.04                0.24
## Entropy_cooc.W.ADC             0.07          -0.02               -0.14
## GLNU_align.H.PET               0.03           0.06               -0.20
## Min_hist.PET                   0.39           0.12                0.25
## Max_hist.PET                   0.44           0.14                0.19
## Mean_hist.PET                  0.42           0.12                0.24
##                     Dissimilarity_cooc.L.ADC Inv_diff_cooc.L.ADC
## Failure                             0.16               -0.07
## Entropy_cooc.W.ADC                 -0.10                0.10
## GLNU_align.H.PET                   -0.17                0.06
## Min_hist.PET                        0.40                0.44
## Max_hist.PET                        0.35                0.51
## Mean_hist.PET                       0.39                0.46
##                     Inv_diff_norm_cooc.L.ADC IDM_cooc.L.ADC IDM_norm_cooc.L.ADC
## Failure                            -0.01          -0.08               -0.01
## Entropy_cooc.W.ADC                  0.04           0.11                0.03
## GLNU_align.H.PET                   -0.03           0.08               -0.04
## Min_hist.PET                        0.53           0.39                0.53
## Max_hist.PET                        0.55           0.47                0.55
## Mean_hist.PET                       0.53           0.41                0.53
##                     Inv_var_cooc.L.ADC Correlation_cooc.L.ADC
## Failure                          -0.08                -0.03
## Entropy_cooc.W.ADC                0.11                 0.10
## GLNU_align.H.PET                  0.08                 0.07
## Min_hist.PET                      0.39                 0.31
## Max_hist.PET                      0.47                 0.38
## Mean_hist.PET                     0.41                 0.32
##                     Autocorrelation_.L.ADC Tendency_cooc.L.ADC Shade_.L.ADC
## Failure                            -0.08                0.21         0.28
## Entropy_cooc.W.ADC                 -0.03               -0.07        -0.13
## GLNU_align.H.PET                   -0.10               -0.14        -0.11
## Min_hist.PET                        0.35                0.24         0.07
## Max_hist.PET                        0.32                0.20         0.07
## Mean_hist.PET                       0.32                0.22         0.09
##                     Prominence_cooc.L.ADC IC1_.L.ADC IC2_.L.ADC
## Failure                              0.29      -0.26       0.12
## Entropy_cooc.W.ADC                  -0.11       0.20      -0.07
## GLNU_align.H.PET                    -0.16       0.17      -0.09
## Min_hist.PET                         0.09      -0.07       0.38
## Max_hist.PET                         0.05      -0.07       0.39
## Mean_hist.PET                        0.08      -0.06       0.37
##                     Coarseness_vdif_.L.ADC Contrast_vdif_.L.ADC
## Failure                              0.20                0.30
## Entropy_cooc.W.ADC                  -0.18               -0.23
## GLNU_align.H.PET                    -0.06               -0.18
```

```
## Min_hist.PET                        0.06                0.10
## Max_hist.PET                        0.04                0.05
## Mean_hist.PET                       0.05                0.09
##                    Busyness_vdif_.L.ADC Complexity_vdif_.L.ADC
## Failure                           -0.16                0.05
## Entropy_cooc.W.ADC                 0.28                0.08
## GLNU_align.H.PET                   0.20               -0.13
## Min_hist.PET                       0.31                0.45
## Max_hist.PET                       0.38                0.43
## Mean_hist.PET                      0.34                0.45
##                    Strength_vdif_.L.ADC SRE_align.L.ADC LRE_align.L.ADC
## Failure                            0.35            0.01           -0.03
## Entropy_cooc.W.ADC                -0.31            0.02            0.06
## GLNU_align.H.PET                  -0.22           -0.05           -0.01
## Min_hist.PET                      -0.04            0.53            0.52
## Max_hist.PET                      -0.09            0.54            0.56
## Mean_hist.PET                     -0.06            0.53            0.53
##                    GLNU_align.L.ADC RLNU_align.L.ADC RP_align.L.ADC
## Failure                       -0.16            -0.17           0.01
## Entropy_cooc.W.ADC             0.24             0.27           0.01
## GLNU_align.H.PET               0.14             0.17          -0.05
## Min_hist.PET                   0.27             0.28           0.53
## Max_hist.PET                   0.34             0.31           0.54
## Mean_hist.PET                  0.30             0.29           0.53
##                    LGRE_align.L.ADC HGRE_align.L.ADC LGSRE_align.L.ADC
## Failure                        0.06            -0.06              0.06
## Entropy_cooc.W.ADC             0.00            -0.03              0.00
## GLNU_align.H.PET               0.08            -0.11              0.08
## Min_hist.PET                   0.10             0.38              0.10
## Max_hist.PET                   0.11             0.35              0.11
## Mean_hist.PET                  0.09             0.35              0.09
##                    HGSRE_align.L.ADC LGHRE_align.L.ADC HGLRE_align.L.ADC
## Failure                        -0.05              0.04             -0.07
## Entropy_cooc.W.ADC             -0.04              0.03             -0.01
## GLNU_align.H.PET               -0.12              0.10             -0.09
## Min_hist.PET                    0.38              0.10              0.37
## Max_hist.PET                    0.35              0.12              0.34
## Mean_hist.PET                   0.35              0.09              0.34
##                    GLNU_norm_align.L.ADC RLNU_norm_align.L.ADC
## Failure                             0.00                 0.02
## Entropy_cooc.W.ADC                  0.01                 0.00
## GLNU_align.H.PET                    0.05                -0.06
## Min_hist.PET                        0.31                 0.53
## Max_hist.PET                        0.35                 0.53
## Mean_hist.PET                       0.32                 0.52
##                    GLVAR_align.L.ADC RLVAR_align.L.ADC Entropy_align.L.ADC
## Failure                         0.23             -0.08                0.00
## Entropy_cooc.W.ADC             -0.10              0.13                0.04
## GLNU_align.H.PET               -0.17              0.13               -0.05
## Min_hist.PET                    0.26              0.31                0.54
## Max_hist.PET                    0.21              0.40                0.55
## Mean_hist.PET                   0.24              0.33                0.53
##                    SZSE.L.ADC LZSE.L.ADC LGLZE.L.ADC HGLZE.L.ADC SZLGE.L.ADC
## Failure                  0.02      -0.07        0.07       -0.06        0.07
```

```
## Entropy_cooc.W.ADC       0.01       0.10       -0.01       -0.03       -0.02
## GLNU_align.H.PET        -0.06       0.05        0.07       -0.11        0.06
## Min_hist.PET             0.53       0.41        0.10        0.39        0.10
## Max_hist.PET             0.53       0.50        0.11        0.35        0.11
## Mean_hist.PET            0.53       0.44        0.09        0.35        0.09
##                    SZHGE.L.ADC LZLGE.L.ADC LZHGE.L.ADC GLNU_area.L.ADC
## Failure                  -0.05        0.00       -0.10           -0.16
## Entropy_cooc.W.ADC       -0.04        0.10        0.03            0.25
## GLNU_align.H.PET         -0.12        0.15       -0.04            0.15
## Min_hist.PET              0.39        0.08        0.32            0.28
## Max_hist.PET              0.35        0.11        0.33            0.33
## Mean_hist.PET             0.36        0.08        0.30            0.30
##                    ZSNU.L.ADC ZSP.L.ADC GLNU_norm.L.ADC ZSNU_norm.L.ADC
## Failure                 -0.17      0.03            0.01            0.04
## Entropy_cooc.W.ADC       0.27     -0.01            0.00           -0.02
## GLNU_align.H.PET         0.17     -0.07            0.05           -0.08
## Min_hist.PET             0.28      0.52            0.31            0.52
## Max_hist.PET             0.31      0.52            0.35            0.51
## Mean_hist.PET            0.29      0.52            0.32            0.51
##                    GLVAR_area.L.ADC ZSVAR.L.ADC Entropy_area.L.ADC
## Failure                        0.23       -0.09              -0.01
## Entropy_cooc.W.ADC            -0.10        0.11               0.06
## GLNU_align.H.PET              -0.18        0.10              -0.04
## Min_hist.PET                   0.26        0.20               0.54
## Max_hist.PET                   0.22        0.32               0.56
## Mean_hist.PET                  0.25        0.24               0.54
##                    Max_cooc.H.ADC Average_cooc.H.ADC Variance_cooc.H.ADC
## Failure                      0.04               0.00                0.00
## Entropy_cooc.W.ADC          -0.01               0.02                0.03
## GLNU_align.H.PET             0.06              -0.05               -0.05
## Min_hist.PET                 0.12               0.54                0.55
## Max_hist.PET                 0.14               0.54                0.56
## Mean_hist.PET                0.11               0.53                0.55
##                    Entropy_cooc.H.ADC DAVE_cooc.H.ADC DVAR_cooc.H.ADC
## Failure                         -0.03            0.03            0.00
## Entropy_cooc.W.ADC               0.06           -0.03            0.00
## GLNU_align.H.PET                -0.04           -0.11           -0.10
## Min_hist.PET                     0.55            0.54            0.53
## Max_hist.PET                     0.57            0.52            0.51
## Mean_hist.PET                    0.56            0.54            0.52
##                    DENT_cooc.H.ADC SAVE_cooc.H.ADC SVAR_cooc.H.ADC
## Failure                       0.00            0.00           -0.02
## Entropy_cooc.W.ADC            0.02            0.02            0.06
## GLNU_align.H.PET             -0.06           -0.05            0.00
## Min_hist.PET                  0.55            0.54            0.49
## Max_hist.PET                  0.55            0.54            0.52
## Mean_hist.PET                 0.55            0.53            0.49
##                    SENT_cooc.H.ADC ASM_cooc.H.ADC Contrast_cooc.H.ADC
## Failure                       0.00           0.05                0.03
## Entropy_cooc.W.ADC            0.04          -0.02               -0.05
## GLNU_align.H.PET             -0.03           0.05               -0.13
## Min_hist.PET                  0.53           0.10                0.51
## Max_hist.PET                  0.56           0.11                0.48
## Mean_hist.PET                 0.54           0.10                0.50
```

```
##                    Dissimilarity_cooc.H.ADC Inv_diff_cooc.H.ADC
## Failure                                0.03               -0.02
## Entropy_cooc.W.ADC                    -0.03                0.09
## GLNU_align.H.PET                      -0.11                0.04
## Min_hist.PET                           0.54                0.44
## Max_hist.PET                           0.52                0.48
## Mean_hist.PET                          0.54                0.44
##                    Inv_diff_norm_cooc.H.ADC IDM_cooc.H.ADC IDM_norm_cooc.H.ADC
## Failure                                0.00          -0.03                0.00
## Entropy_cooc.W.ADC                     0.04           0.11                0.03
## GLNU_align.H.PET                      -0.03           0.07               -0.03
## Min_hist.PET                           0.52           0.38                0.52
## Max_hist.PET                           0.54           0.43                0.54
## Mean_hist.PET                          0.52           0.38                0.52
##                    Inv_var_cooc.H.ADC Correlation_cooc.H.ADC
## Failure                          0.00                 -0.03
## Entropy_cooc.W.ADC               0.07                  0.10
## GLNU_align.H.PET                 0.05                  0.08
## Min_hist.PET                     0.37                  0.29
## Max_hist.PET                     0.42                  0.35
## Mean_hist.PET                    0.37                  0.30
##                    Autocorrelation_cooc.H.ADC Tendency_cooc.H.ADC
## Failure                                -0.01               -0.02
## Entropy_cooc.W.ADC                      0.03                0.06
## GLNU_align.H.PET                       -0.04                0.00
## Min_hist.PET                            0.52                0.49
## Max_hist.PET                            0.53                0.52
## Mean_hist.PET                           0.51                0.49
##                    Shade_cooc.H.ADC Prominence_cooc.H.ADC IC1_d.H.ADC
## Failure                        0.04                -0.03       -0.31
## Entropy_cooc.W.ADC             0.02                 0.09        0.28
## GLNU_align.H.PET               0.04                 0.02        0.20
## Min_hist.PET                   0.11                 0.47       -0.01
## Max_hist.PET                   0.18                 0.51        0.02
## Mean_hist.PET                  0.16                 0.47        0.00
##                    IC2_d.H.ADC Coarseness_vdif.H.ADC Contrast_vdif.H.ADC
## Failure                   0.13                 0.19                0.01
## Entropy_cooc.W.ADC       -0.10                -0.17               -0.02
## GLNU_align.H.PET         -0.11                -0.05               -0.10
## Min_hist.PET              0.38                 0.05                0.52
## Max_hist.PET              0.38                 0.04                0.51
## Mean_hist.PET             0.37                 0.04                0.52
##                    Busyness_vdif.H.ADC Complexity_vdif.H.ADC
## Failure                          -0.17                 0.02
## Entropy_cooc.W.ADC                0.27                -0.03
## GLNU_align.H.PET                  0.16                -0.11
## Min_hist.PET                      0.29                 0.52
## Max_hist.PET                      0.33                 0.51
## Mean_hist.PET                     0.31                 0.52
##                    Strength_vdif.H.ADC SRE_align.H.ADC LRE_align.H.ADC
## Failure                           0.34            0.01           -0.01
## Entropy_cooc.W.ADC               -0.33            0.02            0.05
## GLNU_align.H.PET                 -0.19           -0.05           -0.02
## Min_hist.PET                     -0.06            0.53            0.53
```

```
## Max_hist.PET                    -0.11            0.54            0.56
## Mean_hist.PET                   -0.07            0.53            0.53
##                     GLNU_align.H.ADC RLNU_align.H.ADC RP_align.H.ADC
## Failure                        -0.17           -0.17          0.01
## Entropy_cooc.W.ADC              0.26            0.26          0.02
## GLNU_align.H.PET                0.17            0.17         -0.05
## Min_hist.PET                    0.28            0.28          0.53
## Max_hist.PET                    0.32            0.32          0.54
## Mean_hist.PET                   0.29            0.29          0.53
##                     LGRE_align.H.ADC HGRE_align.H.ADC LGSRE_align.H.ADC
## Failure                         0.03            0.00             0.04
## Entropy_cooc.W.ADC             -0.01            0.02            -0.02
## GLNU_align.H.PET                0.02           -0.05             0.02
## Min_hist.PET                    0.27            0.54             0.26
## Max_hist.PET                    0.28            0.55             0.27
## Mean_hist.PET                   0.26            0.54             0.26
##                     HGSRE_align.H.ADC LGHRE_align.H.ADC HGLRE_align.H.ADC
## Failure                          0.01             0.01            -0.02
## Entropy_cooc.W.ADC               0.02             0.03             0.05
## GLNU_align.H.PET                -0.05             0.05            -0.03
## Min_hist.PET                     0.53             0.30             0.54
## Max_hist.PET                     0.55             0.33             0.56
## Mean_hist.PET                    0.53             0.30             0.54
##                     GLNU_norm_align.H.ADC RLNU_norm_align.H.ADC
## Failure                              0.05                  0.01
## Entropy_cooc.W.ADC                  -0.02                  0.01
## GLNU_align.H.PET                     0.04                 -0.05
## Min_hist.PET                         0.21                  0.53
## Max_hist.PET                         0.22                  0.54
## Mean_hist.PET                        0.20                  0.53
##                     GLVAR_align.H.ADC RLVAR_align.H.ADC Entropy_align.H.ADC
## Failure                          0.00             -0.05                -0.01
## Entropy_cooc.W.ADC               0.02              0.12                 0.04
## GLNU_align.H.PET                -0.05              0.12                -0.04
## Min_hist.PET                     0.54              0.27                 0.54
## Max_hist.PET                     0.55              0.32                 0.56
## Mean_hist.PET                    0.54              0.28                 0.54
##                     SZSE.H.ADC LZSE.H.ADC LGLZE.H.ADC HGLZE.H.ADC SZLGE.H.ADC
## Failure                 0.01      -0.05        0.04        0.01        0.05
## Entropy_cooc.W.ADC      0.01       0.11       -0.03        0.02       -0.04
## GLNU_align.H.PET       -0.05       0.01        0.01       -0.05        0.00
## Min_hist.PET            0.53       0.51        0.25        0.53        0.22
## Max_hist.PET            0.54       0.55        0.25        0.55        0.23
## Mean_hist.PET           0.53       0.52        0.24        0.54        0.22
##                     SZHGE.H.ADC LZLGE.H.ADC LZHGE.H.ADC GLNU_area.H.ADC
## Failure                    0.02       -0.06       -0.05           -0.17
## Entropy_cooc.W.ADC         0.00        0.13        0.12            0.26
## GLNU_align.H.PET          -0.06        0.12        0.00            0.17
## Min_hist.PET               0.53        0.32        0.52            0.28
## Max_hist.PET               0.54        0.38        0.55            0.32
## Mean_hist.PET              0.53        0.34        0.51            0.29
##                     ZSNU.H.ADC ZSP.H.ADC GLNU_norm.H.ADC ZSNU_norm.H.ADC
## Failure                -0.17      0.02            0.05            0.03
## Entropy_cooc.W.ADC      0.26      0.00           -0.02           -0.01
```

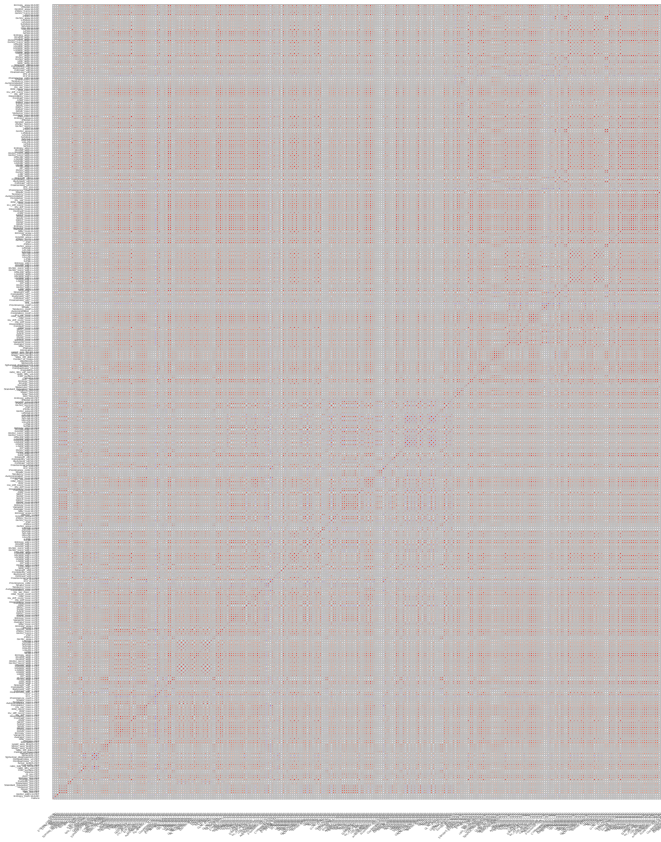
```
## GLNU_align.H.PET         0.17     -0.06            0.04           -0.06
## Min_hist.PET             0.28      0.53            0.21            0.53
## Max_hist.PET             0.32      0.54            0.23            0.53
## Mean_hist.PET            0.30      0.53            0.21            0.53
##                    GLVAR_area.H.ADC ZSVAR.H.ADC Entropy_area.H.ADC
## Failure                        0.01       -0.11              -0.02
## Entropy_cooc.W.ADC             0.01        0.23               0.05
## GLNU_align.H.PET              -0.06        0.13              -0.03
## Min_hist.PET                   0.53        0.27               0.54
## Max_hist.PET                   0.54        0.34               0.56
## Mean_hist.PET                  0.53        0.27               0.54
##                    Max_cooc.W.ADC Average_cooc.W.ADC Variance_cooc.W.ADC
## Failure                      0.06              -0.20               -0.10
## Entropy_cooc.W.ADC          -0.03               0.20                0.28
## GLNU_align.H.PET             0.05               0.08                0.15
## Min_hist.PET                 0.10               0.35                0.18
## Max_hist.PET                 0.12               0.39                0.24
## Mean_hist.PET                0.10               0.34                0.17
##                    DAVE_cooc.W.ADC DVAR_cooc.W.ADC DENT_cooc.W.ADC
## Failure                      -0.06           -0.07           -0.03
## Entropy_cooc.W.ADC            0.19            0.28            0.08
## GLNU_align.H.PET              0.04            0.11           -0.03
## Min_hist.PET                  0.40            0.21            0.53
## Max_hist.PET                  0.42            0.26            0.54
## Mean_hist.PET                 0.39            0.21            0.52
##                    SAVE_cooc.W.ADC SVAR_cooc.W.ADC SENT_cooc.W.ADC
## Failure                      -0.20           -0.10            0.03
## Entropy_cooc.W.ADC            0.19            0.28            0.13
## GLNU_align.H.PET              0.09            0.16            0.08
## Min_hist.PET                  0.34            0.16            0.38
## Max_hist.PET                  0.39            0.22            0.44
## Mean_hist.PET                 0.33            0.15            0.41
##                    ASM_cooc.W.ADC Contrast_cooc.W.ADC Dissimilarity_cooc.W.ADC
## Failure                      0.05               -0.08                    -0.06
## Entropy_cooc.W.ADC          -0.03                0.27                     0.19
## GLNU_align.H.PET             0.05                0.11                     0.04
## Min_hist.PET                 0.10                0.22                     0.40
## Max_hist.PET                 0.11                0.26                     0.42
## Mean_hist.PET                0.10                0.22                     0.39
##                    Inv_diff_cooc.W.ADC Inv_diff_norm_cooc.W.ADC IDM_cooc.W.ADC
## Failure                           0.07                    -0.01           0.05
## Entropy_cooc.W.ADC               -0.08                     0.04          -0.05
## GLNU_align.H.PET                 -0.03                    -0.03          -0.01
## Min_hist.PET                      0.40                     0.53           0.34
## Max_hist.PET                      0.43                     0.55           0.37
## Mean_hist.PET                     0.41                     0.53           0.35
##                    IDM_norm_cooc.W.ADC Inv_var_cooc.W.ADC
## Failure                          -0.01               0.06
## Entropy_cooc.W.ADC                0.03              -0.06
## GLNU_align.H.PET                 -0.03              -0.02
## Min_hist.PET                      0.53               0.34
## Max_hist.PET                      0.55               0.37
## Mean_hist.PET                     0.53               0.34
##                    Correlation_cooc.W.ADC Autocorrelation_cooc.W.ADC
```

```
## Failure                          -0.03                    -0.21
## Entropy_cooc.W.ADC                0.10                     0.20
## GLNU_align.H.PET                  0.07                     0.10
## Min_hist.PET                      0.31                     0.23
## Max_hist.PET                      0.38                     0.27
## Mean_hist.PET                     0.32                     0.21
##                   Tendency_cooc.W.ADC Shade_cooc.W.ADC Prominence_cooc.W.ADC
## Failure                         -0.10            0.02                 -0.10
## Entropy_cooc.W.ADC               0.28            0.18                  0.31
## GLNU_align.H.PET                 0.16            0.03                  0.17
## Min_hist.PET                     0.16            0.16                  0.08
## Max_hist.PET                     0.22            0.22                  0.14
## Mean_hist.PET                    0.15            0.18                  0.07
##                   IC1_d.W.ADC IC2_d.W.ADC Coarseness_vdif.W.ADC
## Failure                 -0.25       0.06                  0.17
## Entropy_cooc.W.ADC       0.21      -0.03                 -0.15
## GLNU_align.H.PET         0.25      -0.10                 -0.04
## Min_hist.PET            -0.08       0.45                  0.07
## Max_hist.PET            -0.05       0.45                  0.06
## Mean_hist.PET           -0.06       0.44                  0.06
##                   Contrast_vdif.W.ADC Busyness_vdif.W.ADC
## Failure                          0.25               -0.02
## Entropy_cooc.W.ADC              -0.18                0.09
## GLNU_align.H.PET                -0.15                0.11
## Min_hist.PET                     0.07                0.32
## Max_hist.PET                     0.04                0.35
## Mean_hist.PET                    0.06                0.34
##                   Complexity_vdif.W.ADC Strength_vdif.W.ADC SRE_align.W.ADC
## Failure                           -0.22               0.28            0.00
## Entropy_cooc.W.ADC                 0.38              -0.21            0.03
## GLNU_align.H.PET                   0.22              -0.23           -0.04
## Min_hist.PET                       0.17              -0.02            0.53
## Max_hist.PET                       0.25              -0.03            0.55
## Mean_hist.PET                      0.18              -0.04            0.53
##                   LRE_align.W.ADC GLNU_align.W.ADC RLNU_align.W.ADC
## Failure                      0.00            -0.15            -0.17
## Entropy_cooc.W.ADC           0.03             0.21             0.27
## GLNU_align.H.PET            -0.04             0.13             0.17
## Min_hist.PET                 0.53             0.29             0.27
## Max_hist.PET                 0.55             0.34             0.31
## Mean_hist.PET                0.53             0.32             0.29
##                   RP_align.W.ADC LGRE_align.W.ADC HGRE_align.W.ADC
## Failure                     0.00             0.06            -0.20
## Entropy_cooc.W.ADC          0.03            -0.01             0.20
## GLNU_align.H.PET           -0.04             0.08             0.11
## Min_hist.PET                0.53             0.09             0.22
## Max_hist.PET                0.55             0.10             0.27
## Mean_hist.PET               0.53             0.08             0.20
##                   LGSRE_align.W.ADC HGSRE_align.W.ADC LGHRE_align.W.ADC
## Failure                        0.06            -0.20              0.04
## Entropy_cooc.W.ADC            -0.01             0.20              0.01
## GLNU_align.H.PET               0.07             0.11              0.09
## Min_hist.PET                   0.09             0.22              0.09
## Max_hist.PET                   0.10             0.27              0.10
```

```
## Mean_hist.PET                  0.09              0.20              0.08
##                     HGLRE_align.W.ADC GLNU_norm_align.W.ADC
## Failure                         -0.20                  0.09
## Entropy_cooc.W.ADC               0.20                 -0.08
## GLNU_align.H.PET                 0.11                  0.01
## Min_hist.PET                     0.22                  0.19
## Max_hist.PET                     0.28                  0.20
## Mean_hist.PET                    0.21                  0.18
##                     RLNU_norm_align.W.ADC GLVAR_align.W.ADC RLVAR_align.W.ADC
## Failure                              0.00             -0.10              0.03
## Entropy_cooc.W.ADC                   0.03              0.29              0.00
## GLNU_align.H.PET                    -0.04              0.15              0.06
## Min_hist.PET                         0.53              0.19              0.22
## Max_hist.PET                         0.54              0.26              0.25
## Mean_hist.PET                        0.53              0.19              0.22
##                     Entropy_align.W.ADC SZSE.W.ADC LZSE.W.ADC LGLZE.W.ADC
## Failure                           -0.07       0.00      -0.01        0.06
## Entropy_cooc.W.ADC                 0.11       0.03       0.03       -0.02
## GLNU_align.H.PET                  -0.02      -0.04      -0.03        0.07
## Min_hist.PET                       0.52       0.53       0.52        0.09
## Max_hist.PET                       0.54       0.55       0.54        0.10
## Mean_hist.PET                      0.51       0.53       0.52        0.09
##                     HGLZE.W.ADC SZLGE.W.ADC SZHGE.W.ADC LZLGE.W.ADC LZHGE.W.ADC
## Failure                   -0.20        0.07       -0.20        0.01       -0.21
## Entropy_cooc.W.ADC         0.20       -0.03        0.20        0.06        0.20
## GLNU_align.H.PET           0.11        0.06        0.11        0.13        0.11
## Min_hist.PET               0.22        0.09        0.22        0.06        0.23
## Max_hist.PET               0.28        0.10        0.27        0.09        0.28
## Mean_hist.PET              0.20        0.09        0.20        0.06        0.21
##                     GLNU_area.W.ADC ZSNU.W.ADC ZSP.W.ADC GLNU_norm.W.ADC
## Failure                       -0.15      -0.17      0.00            0.11
## Entropy_cooc.W.ADC             0.21       0.27      0.03           -0.08
## GLNU_align.H.PET               0.13       0.17     -0.04            0.01
## Min_hist.PET                   0.29       0.28      0.53            0.19
## Max_hist.PET                   0.34       0.31      0.55            0.20
## Mean_hist.PET                  0.32       0.29      0.53            0.19
##                     ZSNU_norm.W.ADC GLVAR_area.W.ADC ZSVAR.W.ADC
## Failure                        0.01            -0.10       -0.01
## Entropy_cooc.W.ADC             0.02             0.29        0.04
## GLNU_align.H.PET              -0.05             0.15        0.06
## Min_hist.PET                   0.53             0.19        0.26
## Max_hist.PET                   0.54             0.26        0.31
## Mean_hist.PET                  0.53             0.19        0.27
##                     Entropy_area.W.ADC
## Failure                          -0.06
## Entropy_cooc.W.ADC                0.11
## GLNU_align.H.PET                  0.01
## Min_hist.PET                      0.53
## Max_hist.PET                      0.56
## Mean_hist.PET                     0.53
```

```
#Calculate correlation using Hmisc package
#pearson_cor_radio_df <- rcorr(as.matrix(radio_df_subset), type=c("pearson"))
#pearson_cor_radio_df
```

```r
#Visualization
ggcorrplot(cor_radio_df,
           lab_size = 4.5,
           tl.cex = 1)
```



Visualization of correleation of the whole dataset

Split the data into training

```r
# #Split the dataset - Aborted
# index_1 <- sample(1:nrow(radio_df), round(nrow(radio_df) * 0.8))
# radio_train <- radio_df[index_1, ]
# radio_test  <- radio_df[-index_1, ]

# Conver the matrix to dataframe
scaled_df <- as.data.frame(scaled_df)

# Combine two dataframes
scaled_df2 <- cbind(scaled_df, radio_df['Failure.binary'])
scaled_df3 <- cbind(scaled_df2, radio_df['Institution'])

# Set seeds for reproducing
seeds <- set.seed(100)
```

```
# Split the dataset
data_split <- initial_split(scaled_df3, prop = 0.8, strata="Failure", seed = seeds)
radio_train <- training(data_split)
radio_test <- testing(data_split)

# Consistent categorical levels
blueprint <- recipe(Failure ~ ., data = radio_train) %>%
  step_other(all_nominal(), threshold = 0.005)
```

Create the Stacking model

```
# initialize the h2o library
h2o.init()
```

```
##  Connection successful!
##
## R is connected to the H2O cluster:
##     H2O cluster uptime:         10 days 19 hours
##     H2O cluster timezone:       America/Toronto
##     H2O data parsing timezone:  UTC
##     H2O cluster version:        3.38.0.1
##     H2O cluster version age:    2 months and 26 days
##     H2O cluster name:           H2O_started_from_R_Ray_ctn835
##     H2O cluster total nodes:    1
##     H2O cluster total memory:   0.35 GB
##     H2O cluster total cores:    4
##     H2O cluster allowed cores:  4
##     H2O cluster healthy:        TRUE
##     H2O Connection ip:          localhost
##     H2O Connection port:        54321
##     H2O Connection proxy:       NA
##     H2O Internal Security:      FALSE
##     R Version:                  R version 4.2.1 (2022-06-23)
```

```
train_df <- prep(blueprint, training = radio_train, retain=TRUE) %>% juice() %>%
  as.h2o()
```

```
##   |                                                                      |
```

```
test_df <- prep(blueprint, training = radio_train, retain=TRUE) %>%
  bake(new_data = radio_test) %>%
  as.h2o()
```

```
##   |                                                                      |
```

```
# Identify predictors and response
y <- "Failure.binary"     #response
x <- setdiff(names(train_df), y)     #predictors
```

```r
# Cross_validation folds number
nfolds <- 10

# Generate 3 models (GBM + RF + KNN)
# GBM
gbm <- h2o.gbm(x = x,
                   y = y,
                   training_frame = train_df,
                   nfolds = nfolds,
                   keep_cross_validation_predictions = TRUE,
                   seed = 100)
```

```
## Warning in .h2o.processResponseWarnings(res): We have detected that your response column has only 2 u
```

```
##   |                                                                              |
```

```r
# RF
rf <- h2o.randomForest(x = x,
                           y = y,
                           training_frame = train_df,
                           nfolds = nfolds,
                           keep_cross_validation_predictions = TRUE,
                           seed = 100)
```

```
## Warning in .h2o.processResponseWarnings(res): We have detected that your response column has only 2 u
```

```
##   |                                                                              |
```

```r
# XGBoost
xgb <- h2o.xgboost(x = x,
                       y = y,
                       training_frame = train_df,
                       nfolds = nfolds,
                       keep_cross_validation_predictions = TRUE,
                       booster = "dart",
                       normalize_type = "tree",
                       seed = 100)
```

```
## Warning in .h2o.processResponseWarnings(res): We have detected that your response column has only 2 u
```

```
##   |                                                                              |
```

```r
# Stack each model above
stacking <- h2o.stackedEnsemble(x = x,
                                y = y,
                                metalearner_algorithm="drf",
                                training_frame = train_df,
                                base_models = list(gbm, rf, xgb))
```

```
## Warning in .h2o.processResponseWarnings(res): We have detected that your response column has only 2 u
```

```
##   |                                                                              |
```

```
stacking
```

```
## Model Details:
## ==============
##
## H2ORegressionModel: stackedensemble
## Model ID:  StackedEnsemble_model_R_1670212875445_5672
## Number of Base Models: 3
##
## Base Models (count by algorithm type):
##
##     drf     gbm xgboost
##       1       1       1
##
## Metalearner:
##
## Metalearner algorithm: drf
## Metalearner hyperparameters:
##
##
## H2ORegressionMetrics: stackedensemble
## ** Reported on training data. **
##
## MSE:  0.008163599
## RMSE:  0.09035264
## MAE:  0.03495572
## RMSLE:  0.06195973
## Mean Residual Deviance :  0.008163599
```

Print the AUC values for training

```
# Compute the predicted probablities for traning set and test set
train_prob <- predict(stacking, train_df, type="prob")
```

```
##   |                                                                              |
```

```
train_prob_df <- as.data.frame(train_prob)
a <- unlist(train_prob_df)
a
```

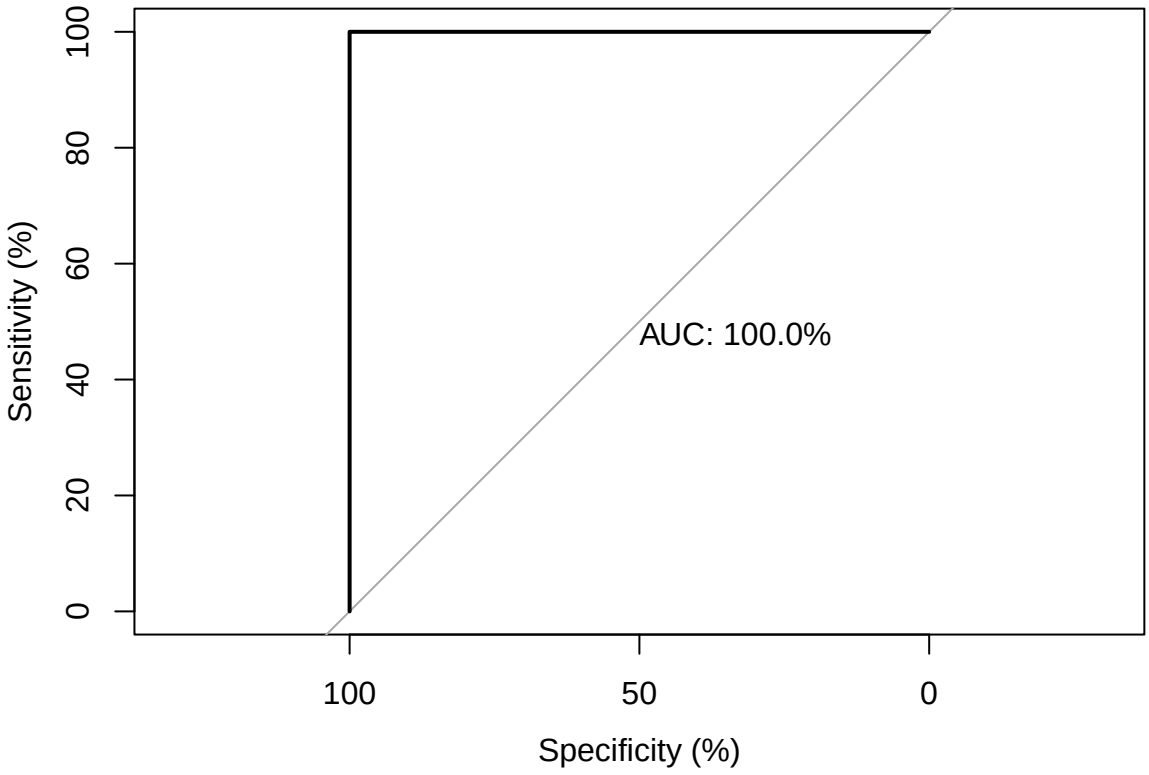
```
##    predict1    predict2    predict3    predict4    predict5    predict6
## 1.000000000 1.000000000 0.840000000 1.000000000 1.000000000 1.000000000
##    predict7    predict8    predict9   predict10   predict11   predict12
## 1.000000000 0.020000000 1.000000000 1.000000000 0.920000000 1.000000000
##   predict13   predict14   predict15   predict16   predict17   predict18
## 1.000000000 0.023333333 0.000000000 0.002857143 1.000000000 0.000000000
##   predict19   predict20   predict21   predict22   predict23   predict24
## 0.053333333 0.080000000 0.000000000 0.100000000 0.340000000 1.000000000
##   predict25   predict26   predict27   predict28   predict29   predict30
## 0.660000000 1.000000000 0.080000000 0.010000000 0.980000000 1.000000000
```

```
##   predict31   predict32   predict33   predict34   predict35   predict36
## 1.000000000 1.000000000 0.000000000 0.920000000 0.980000000 0.010000000
##   predict37   predict38   predict39   predict40   predict41   predict42
## 1.000000000 1.000000000 1.000000000 1.000000000 0.685000000 0.840000000
##   predict43   predict44   predict45   predict46   predict47   predict48
## 1.000000000 0.840000000 1.000000000 1.000000000 1.000000000 1.000000000
##   predict49   predict50   predict51   predict52   predict53   predict54
## 0.023333333 0.000000000 0.000000000 0.980000000 0.002857143 1.000000000
##   predict55   predict56   predict57   predict58   predict59   predict60
## 0.000000000 0.080000000 0.020000000 0.955000000 1.000000000 0.020000000
##   predict61   predict62   predict63   predict64   predict65   predict66
## 0.043333333 0.212857143 0.000000000 1.000000000 0.002857143 1.000000000
##   predict67   predict68   predict69   predict70   predict71   predict72
## 0.154000000 1.000000000 0.570000000 1.000000000 1.000000000 0.980000000
##   predict73   predict74   predict75   predict76   predict77   predict78
## 0.000000000 0.000000000 0.000000000 0.000000000 0.040000000 0.000000000
##   predict79   predict80   predict81   predict82   predict83   predict84
## 0.030000000 0.102857143 0.960000000 0.530000000 0.000000000 0.002857143
##   predict85   predict86   predict87   predict88   predict89   predict90
## 0.000000000 0.000000000 0.000000000 0.030000000 0.000000000 0.000000000
##   predict91   predict92   predict93   predict94   predict95   predict96
## 1.000000000 1.000000000 0.003333333 0.002857143 0.000000000 0.070000000
##   predict97   predict98   predict99  predict100  predict101  predict102
## 0.003333333 0.000000000 0.000000000 1.000000000 0.000000000 1.000000000
##  predict103  predict104  predict105  predict106  predict107  predict108
## 0.200000000 0.000000000 0.010000000 0.000000000 0.020000000 0.080000000
##  predict109  predict110  predict111  predict112  predict113  predict114
## 0.003333333 0.600000000 0.000000000 0.020000000 0.980000000 0.002857143
##  predict115  predict116  predict117  predict118  predict119  predict120
## 0.000000000 0.130000000 0.020000000 0.002857143 0.000000000 0.020000000
##  predict121  predict122  predict123  predict124  predict125  predict126
## 0.022857143 0.020000000 0.002857143 0.003333333 0.220000000 0.002857143
##  predict127  predict128  predict129  predict130  predict131  predict132
## 0.000000000 0.000000000 0.000000000 0.000000000 0.000000000 0.002857143
##  predict133  predict134  predict135  predict136  predict137  predict138
## 0.000000000 0.002857143 0.000000000 0.000000000 0.000000000 0.955000000
##  predict139  predict140  predict141  predict142  predict143  predict144
## 0.000000000 0.000000000 0.000000000 0.000000000 0.002857143 0.002857143
##  predict145  predict146  predict147  predict148  predict149  predict150
## 0.070000000 0.000000000 0.000000000 0.003333333 0.000000000 0.003333333
##  predict151  predict152  predict153  predict154  predict155  predict156
## 0.000000000 0.000000000 0.000000000 0.000000000 0.020000000 0.210000000
##  predict157
## 0.000000000
```

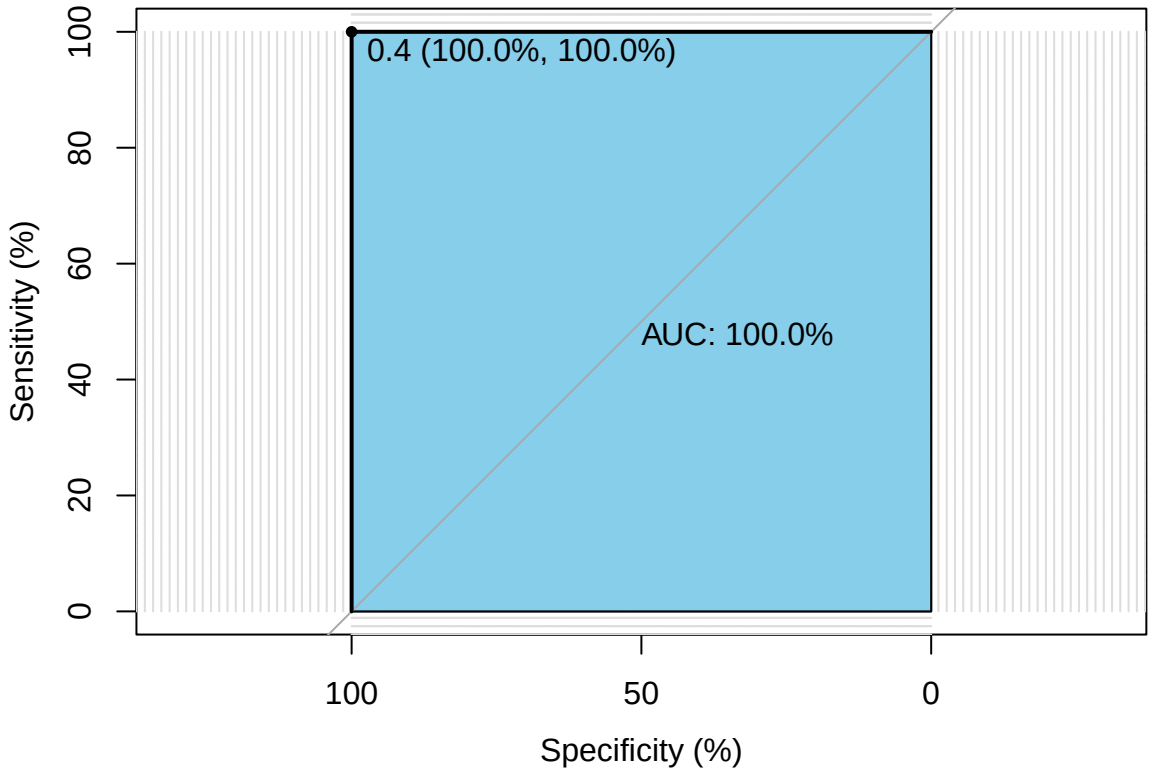
```
train_df <- as.data.frame(train_df)

# ROC plot for training data
roc_res <- roc(train_df$Failure.binary ~ a, plot=TRUE, legacy.axes=FALSE,
    percent=TRUE, col="black", lwd=2, print.auc=TRUE)
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```




```
# # Uncomment this for just result
# roc_res

# AUC value showing on the plot
plot(roc_res, print.auc=TRUE, auc.polygon=TRUE, grid=c(0.1, 0.2), max.auc.polygon=TRUE,auc.polygon.col=
```



Plot the graph for testing

```
# Compute the predicted probablities for traning set and test set
test_prob <- predict(stacking, test_df, type="prob")
```

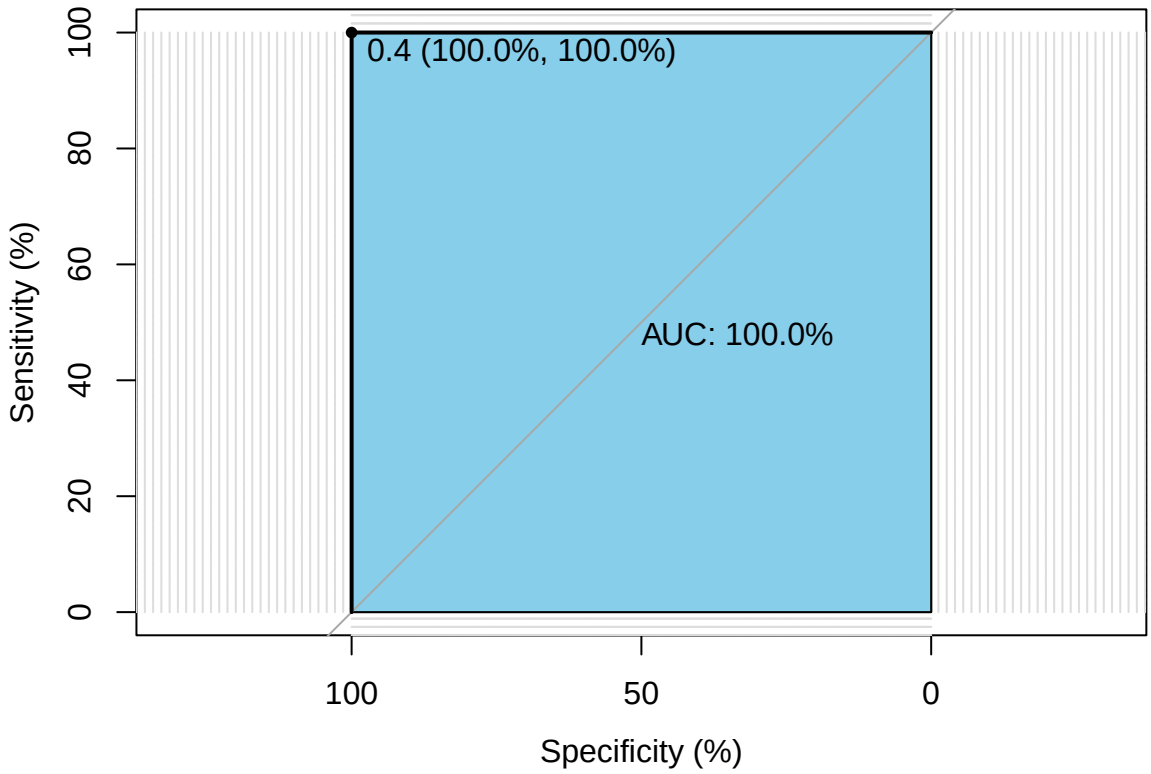
```
##   |                                                                      |
```

```
test_prob_df <- as.data.frame(test_prob)
a <- unlist(test_prob_df)
a
```

```
##    predict1    predict2    predict3    predict4    predict5    predict6
## 1.000000000 0.020000000 0.430000000 0.960000000 1.000000000 1.000000000
##    predict7    predict8    predict9   predict10   predict11   predict12
## 0.270000000 0.270000000 0.043333333 0.173333333 0.002857143 0.100000000
##   predict13   predict14   predict15   predict16   predict17   predict18
## 0.300000000 0.020000000 0.226666667 0.000000000 0.070000000 0.200000000
##   predict19   predict20   predict21   predict22   predict23   predict24
## 0.330000000 0.410000000 0.040000000 0.202857143 0.253333334 0.920000000
##   predict25   predict26   predict27   predict28   predict29   predict30
## 0.805000001 0.320000000 0.060000000 0.920000000 0.770000000 0.030000000
##   predict31   predict32   predict33   predict34   predict35   predict36
## 0.060000000 0.410000000 0.880000000 0.770000000 0.020000000 0.050000000
```

```
##   predict37   predict38   predict39   predict40
## 0.110000000 0.890000000 0.043333333 0.140000000
```

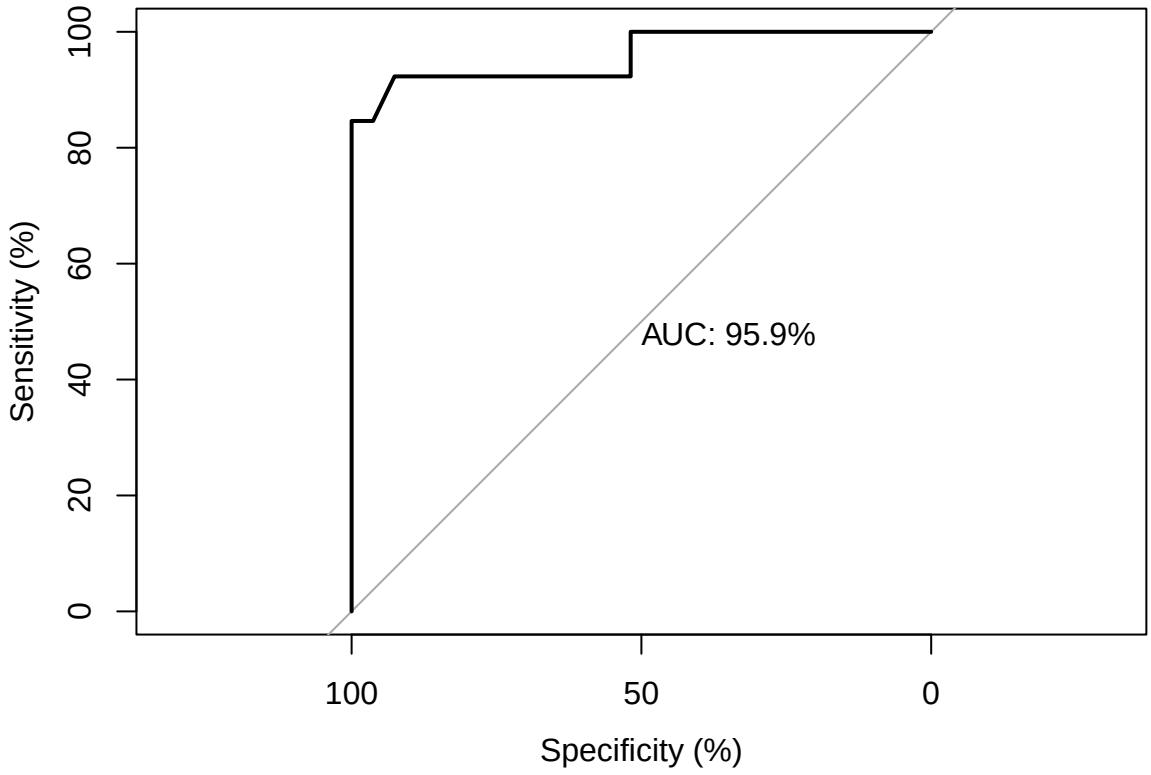
```
test_df <- as.data.frame(test_df)

# AUC value showing on the plot
plot(roc_res, print.auc=TRUE, auc.polygon=TRUE, grid=c(0.1, 0.2), max.auc.polygon=TRUE,auc.polygon.col=
```




```
# ROC plot for training data
roc_res <- roc(test_df$Failure.binary ~ a, plot=TRUE, legacy.axes=FALSE,
    percent=TRUE, col="black", lwd=2, print.auc=TRUE)
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```



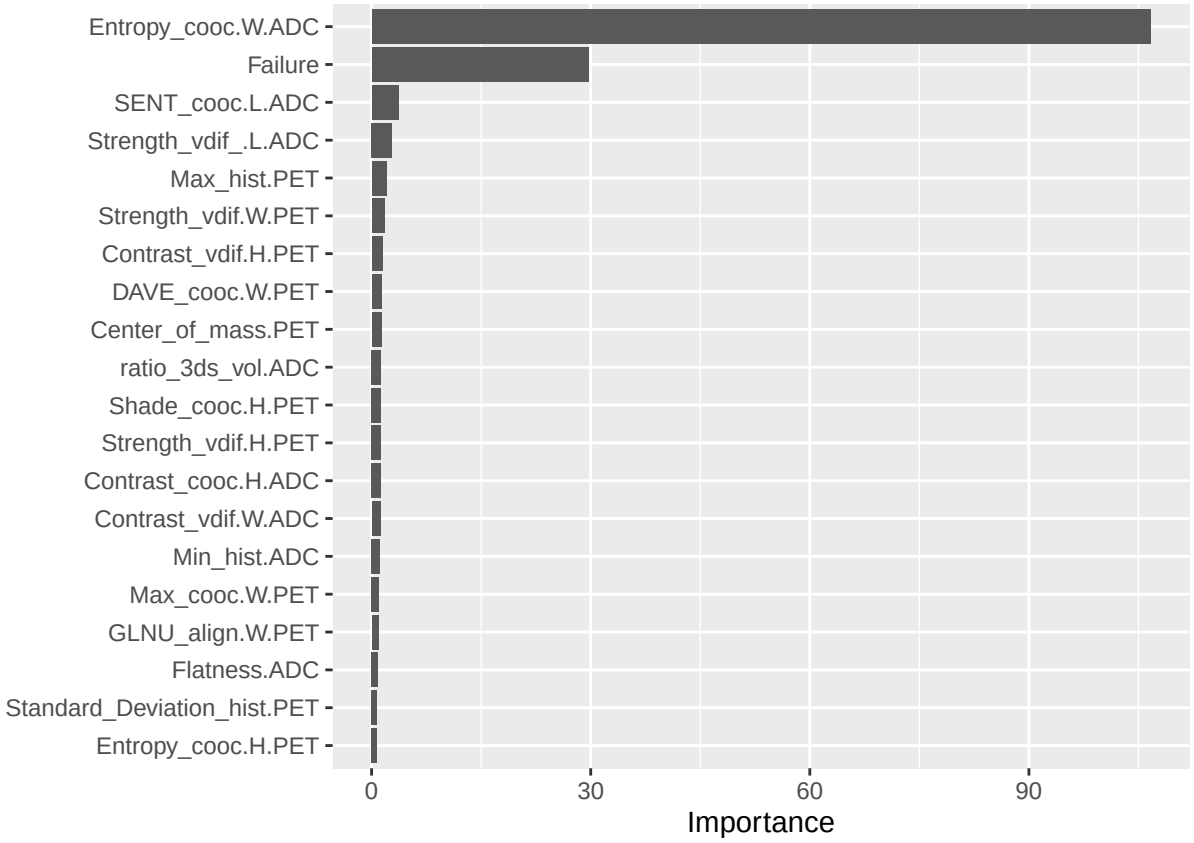

```
# # Uncomment this for just results
# roc_res
```

For model performence (Uncomment this to run)

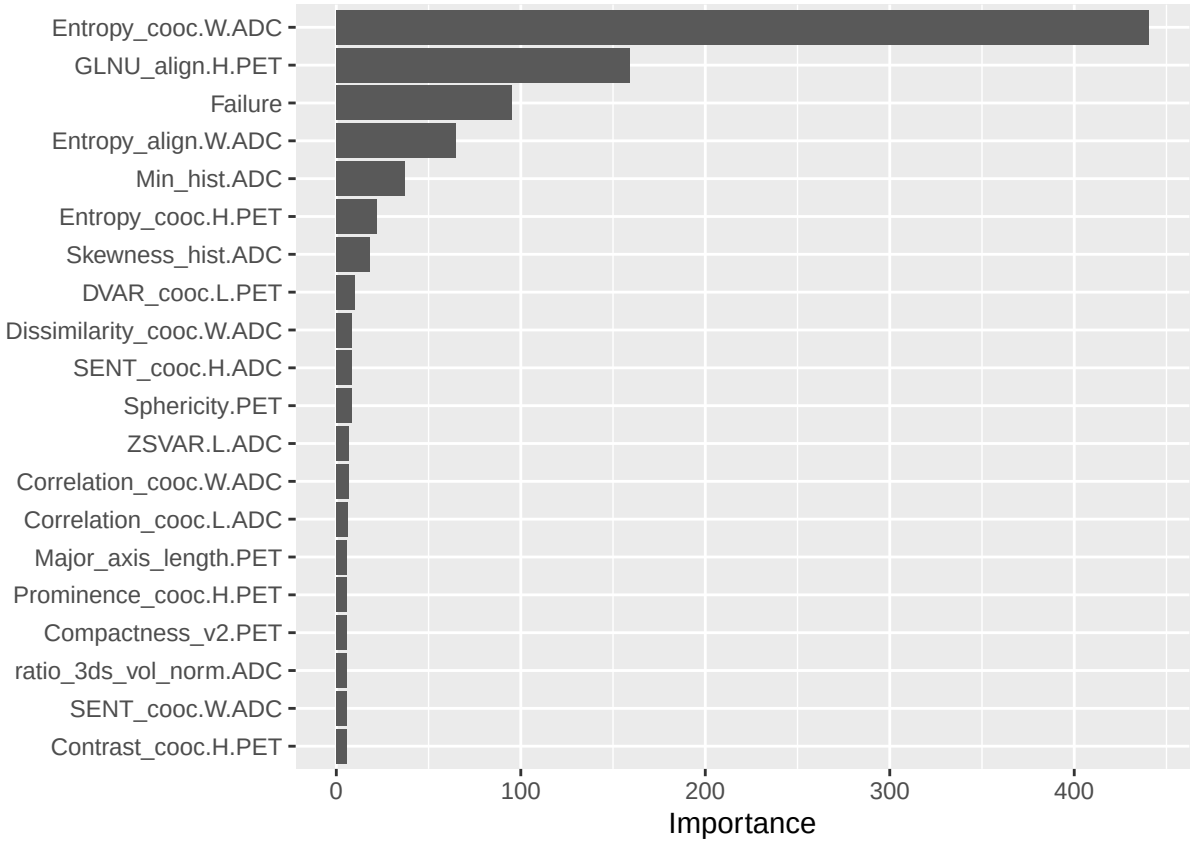
```
# # Predication
# pred <- predication(train_df)
#
# # Compare to base learner performance on the test set
# perf_gbm_test <- performance(train_prob, "sens", "spec")
# perf_rf_test <- performance(rf, newdata = train_df)
# perf_xgb_test <- performance(xgb, newdata = train_df)
#
# baselearner_best_auc_test <- max(h2o.auc(perf_gbm_test), h2o.auc(perf_rf_test), h2o.auc(perf_xgb_test
#
# ensemble_auc_test <- h2o.auc(perf)
#
# print(sprintf("Best Base-learner Test AUC:  %s", baselearner_best_auc_test))
# print(sprintf("Ensemble Test AUC:  %s", ensemble_auc_test))
```

Feature importance visualization

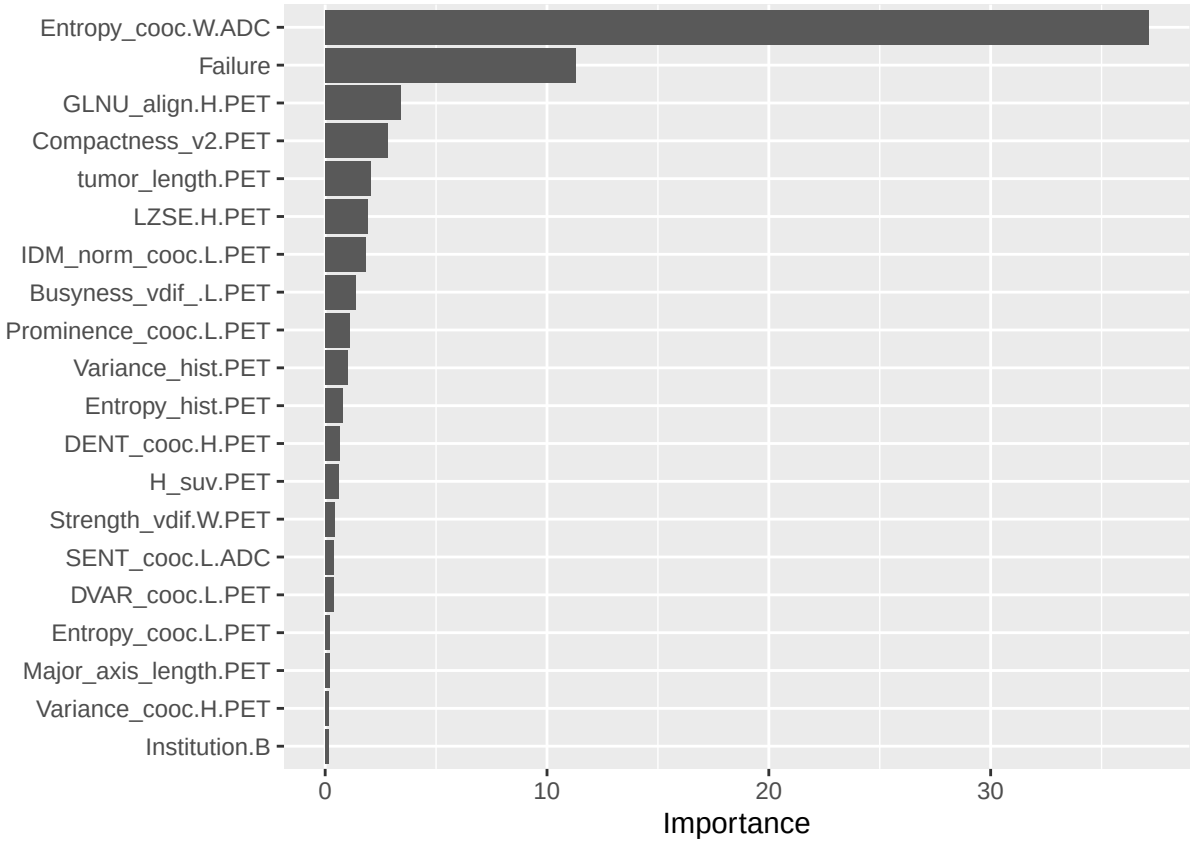
```
# General way to do it
vip::vip(gbm, num_features = 20)
```



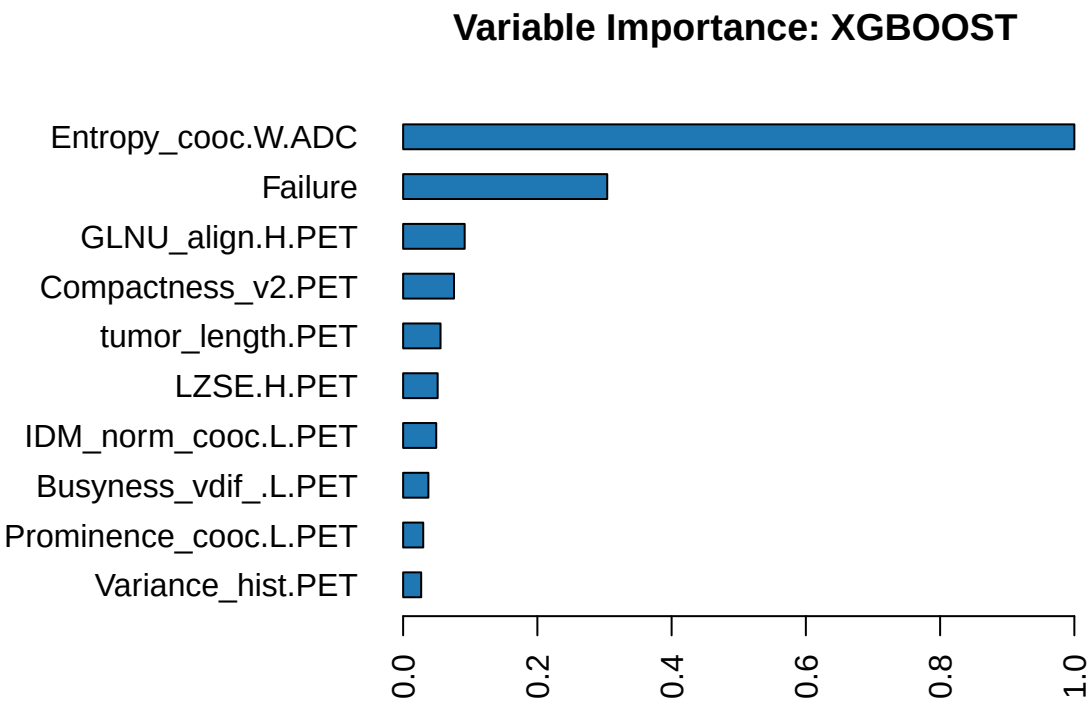

```
vip::vip(rf, num_features = 20)
```




```
vip::vip(xgb, num_features = 20)
```




```
#Another way to do it
h2o.varimp_plot(xgb)
```


Variable Importance: XGBOOST
Entropy_cooc.W.ADC
Failure
GLNU_align.H.PET
Compactness_v2.PET
tumor_length.PET
LZSE.H.PET
IDM_norm_cooc.L.PET
Busyness_vdif_.L.PET
Prominence_cooc.L.PET
Variance_hist.PET
0.0
0.2
0.4
0.6
0.8
1.0