DATA 624 - Homework 8

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Table of Contents

Exercises 7.2 & 7.5 from the K&J book.

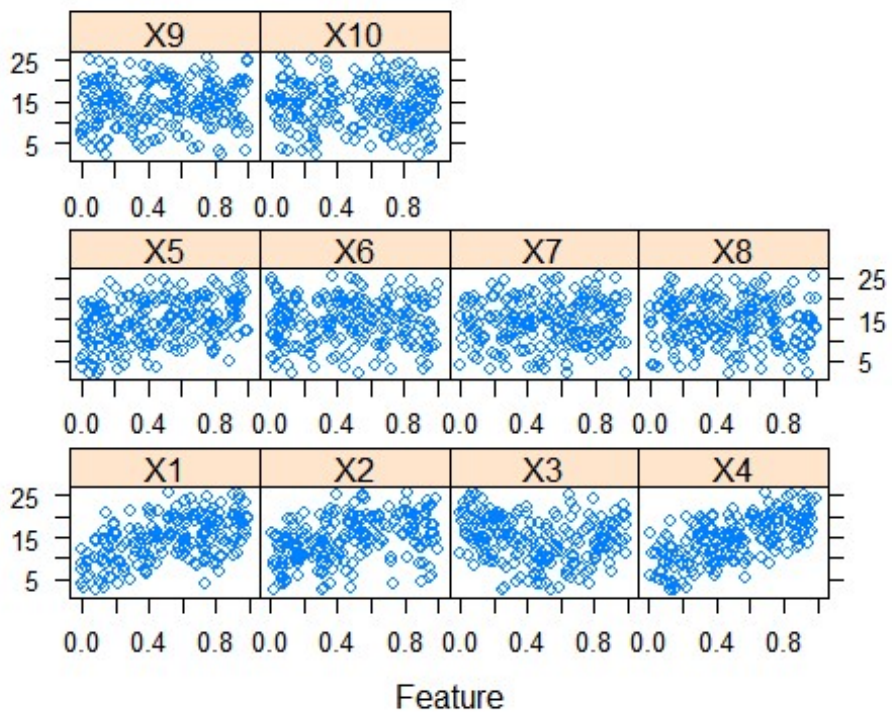
```
library(mlbench)
library(caret)
library(earth)
library(kernlab)
library(nnet)
library(ggplot2)
library(mice)
```

```
library(AppliedPredictiveModeling)
library(magrittr)
library(corrplot)
library(PerformanceAnalytics)
```

7.2

Load Data

```
set.seed(42)
trainingData <- mlbench.friedman1(200, sd = 1)
trainingData$x <- data.frame(trainingData$x)
featurePlot(trainingData$x, trainingData$y)
```




```
testData <- mlbench.friedman1(5000, sd = 1)
testData$x <- data.frame(testData$x)
```

Let's tune several model by using GridSearch

```
evaluation = function(method, gridSearch = NULL)
{
  Model = train(x = trainingData$x, y = trainingData$y, method = method,
tuneGrid = gridSearch, preProcess = c('center', 'scale'), trControl =
trainControl(method='cv'))
  Pred = predict(Model, newdata = testData$x)
  performance = postResample(Pred, testData$y)
  print(performance)
}
```

KNN Model Performace

```
knn_rst = evaluation('knn')
```

```
##      RMSE  Rsquared       MAE
## 3.0850456 0.6333506 2.4435998
```

Neural Net Perforance

```
nnetGrid = expand.grid(decay = c(0,0.01, .1), size = c(1:10))
net_rst = evaluation('nnet', nnetGrid)
```

```
## # weights:  13
## initial  value 39407.931493
## final  value 36876.801559
## converged
## # weights:  13
## initial  value 40282.461584
## iter  10 value 36903.200892
## iter  20 value 36878.402987
## iter  30 value 36877.603770
## final  value 36877.586809
## converged
## # weights:  13
## initial  value 38537.604873
## iter  10 value 36882.366374
## final  value 36882.220772
## converged
## # weights:  25
## initial  value 39844.812321
## final  value 36876.801559
## converged
## # weights:  25
## initial  value 39826.023558
## iter  10 value 36913.594317
## iter  20 value 36878.542432
## iter  30 value 36877.461139
## final  value 36877.431878
## converged
## # weights:  25
## initial  value 39432.307513
## iter  10 value 36882.987689
## final  value 36881.256506
## converged
## # weights:  37
## initial  value 39987.099238
## final  value 36876.801559
## converged
## # weights:  37
## initial  value 39697.086453
## iter  10 value 36917.332758
## iter  20 value 36878.168469
```

```
## iter  30 value 36877.381466
## final  value 36877.350390
## converged
## # weights:  37
## initial  value 39142.684867
## iter  10 value 36883.034147
## iter  20 value 36880.711725
## iter  20 value 36880.711487
## iter  20 value 36880.711390
## final  value 36880.711390
## converged
## # weights:  49
## initial  value 40531.188746
## final  value 36876.801559
## converged
## # weights:  49
## initial  value 39609.807287
## iter  10 value 36888.518962
## iter  20 value 36877.676946
## iter  30 value 36877.312417
## final  value 36877.295016
## converged
## # weights:  49
## initial  value 39493.822763
## iter  10 value 36894.906487
## iter  20 value 36880.341346
## iter  20 value 36880.341013
## iter  20 value 36880.340936
## final  value 36880.340936
## converged
## # weights:  61
## initial  value 40462.868228
## final  value 36876.801559
## converged
## # weights:  61
## initial  value 39583.317137
## iter  10 value 36942.764683
## iter  20 value 36879.422313
## iter  30 value 36877.438443
## iter  40 value 36877.260292
## final  value 36877.253740
## converged
## # weights:  61
## initial  value 38112.484682
## iter  10 value 36892.749381
## iter  20 value 36880.062679
## iter  20 value 36880.062530
## iter  20 value 36880.062525
## final  value 36880.062525
## converged
```

```
## # weights:  73
## initial  value 40042.069963
## final  value 36876.801559
## converged
## # weights:  73
## initial  value 39558.675868
## iter  10 value 36897.525975
## iter  20 value 36877.728042
## iter  30 value 36877.265096
## final  value 36877.222928
## converged
## # weights:  73
## initial  value 38597.572521
## iter  10 value 36898.103446
## iter  20 value 36879.845968
## final  value 36879.840430
## converged
## # weights:  85
## initial  value 37935.544248
## final  value 36876.801559
## converged
## # weights:  85
## initial  value 38321.658456
## iter  10 value 36922.726113
## iter  20 value 36878.675797
## iter  30 value 36877.230890
## iter  40 value 36877.197520
## final  value 36877.196127
## converged
## # weights:  85
## initial  value 38612.070371
## iter  10 value 36909.085483
## iter  20 value 36879.662981
## final  value 36879.655820
## converged
## # weights:  97
## initial  value 39726.959354
## final  value 36876.801559
## converged
## # weights:  97
## initial  value 40259.552072
## iter  10 value 36888.587141
## iter  20 value 36877.266162
## final  value 36877.175374
## converged
## # weights:  97
## initial  value 39550.937249
## iter  10 value 36908.874998
## iter  20 value 36879.501693
## final  value 36879.498336
```

```
## converged
## # weights:  109
## initial  value 38417.963583
## final  value 36876.801559
## converged
## # weights:  109
## initial  value 38945.519117
## iter  10 value 36882.105805
## iter  20 value 36877.200203
## final  value 36877.156529
## converged
## # weights:  109
## initial  value 39181.163352
## iter  10 value 36913.315350
## iter  20 value 36879.364067
## final  value 36879.361314
## converged
## # weights:  121
## initial  value 38436.220719
## final  value 36876.801559
## converged
## # weights:  121
## initial  value 40566.377804
## iter  10 value 36932.762929
## iter  20 value 36879.233226
## iter  30 value 36877.264133
## iter  40 value 36877.142618
## final  value 36877.139429
## converged
## # weights:  121
## initial  value 40738.527360
## iter  10 value 36880.404580
## final  value 36879.240244
## converged
## # weights:  13
## initial  value 40612.135988
## final  value 37490.621247
## converged
## # weights:  13
## initial  value 40339.440870
## iter  10 value 37521.590933
## iter  20 value 37491.796907
## iter  30 value 37491.413744
## final  value 37491.409036
## converged
## # weights:  13
## initial  value 38923.913265
## iter  10 value 37496.998666
## final  value 37496.051912
## converged
```

```
## # weights:  25
## initial  value 40355.503139
## final  value 37490.621247
## converged
## # weights:  25
## initial  value 39952.087081
## iter  10 value 37528.282612
## iter  20 value 37491.850617
## iter  30 value 37491.277537
## iter  40 value 37491.252599
## iter  40 value 37491.252549
## iter  40 value 37491.252540
## final  value 37491.252540
## converged
## # weights:  25
## initial  value 39856.114167
## iter  10 value 37495.853061
## final  value 37495.085544
## converged
## # weights:  37
## initial  value 40128.668636
## final  value 37490.621247
## converged
## # weights:  37
## initial  value 39707.913361
## iter  10 value 37538.749551
## iter  20 value 37492.561097
## iter  30 value 37491.250668
## iter  40 value 37491.170955
## final  value 37491.170002
## converged
## # weights:  37
## initial  value 40625.486972
## iter  10 value 37506.852562
## iter  20 value 37494.539664
## iter  20 value 37494.539454
## iter  20 value 37494.539343
## final  value 37494.539343
## converged
## # weights:  49
## initial  value 39769.456998
## final  value 37490.621247
## converged
## # weights:  49
## initial  value 38670.173529
## iter  10 value 37518.983836
## iter  20 value 37492.473367
## iter  30 value 37491.187453
## iter  40 value 37491.116365
## final  value 37491.114780
```

```
## converged
## # weights:  49
## initial  value 40344.211380
## iter  10 value 37508.328098
## final  value 37494.168051
## converged
## # weights:  61
## initial  value 40256.213778
## final  value 37490.621247
## converged
## # weights:  61
## initial  value 40090.511678
## iter  10 value 37547.181085
## iter  20 value 37492.188988
## iter  30 value 37491.100064
## iter  40 value 37491.075206
## final  value 37491.073624
## converged
## # weights:  61
## initial  value 39742.374327
## iter  10 value 37495.891267
## iter  20 value 37493.889285
## iter  20 value 37493.889147
## iter  20 value 37493.889093
## final  value 37493.889093
## converged
## # weights:  73
## initial  value 40012.872081
## final  value 37490.621247
## converged
## # weights:  73
## initial  value 39887.232829
## iter  10 value 37566.638607
## iter  20 value 37492.908359
## iter  30 value 37491.237734
## iter  40 value 37491.049328
## final  value 37491.042970
## converged
## # weights:  73
## initial  value 40888.995354
## iter  10 value 37521.616520
## iter  20 value 37493.671694
## final  value 37493.666467
## converged
## # weights:  85
## initial  value 40526.295074
## final  value 37490.621247
## converged
## # weights:  85
## initial  value 38567.874281
```

```
## iter  10 value 37524.149205
## iter  20 value 37492.603016
## iter  30 value 37491.063992
## final  value 37491.017195
## converged
## # weights:  85
## initial  value 40297.576176
## iter  10 value 37519.352249
## iter  20 value 37493.484060
## final  value 37493.481461
## converged
## # weights:  97
## initial  value 39678.994136
## final  value 37490.621247
## converged
## # weights:  97
## initial  value 40688.591504
## iter  10 value 37500.696061
## iter  20 value 37491.099075
## final  value 37490.996189
## converged
## # weights:  97
## initial  value 38596.041653
## iter  10 value 37493.494829
## final  value 37493.323634
## converged
## # weights:  109
## initial  value 40164.093187
## final  value 37490.621247
## converged
## # weights:  109
## initial  value 40593.582814
## iter  10 value 37572.296300
## iter  20 value 37493.185368
## iter  30 value 37491.167226
## iter  40 value 37490.984786
## final  value 37490.976401
## converged
## # weights:  109
## initial  value 39370.089045
## iter  10 value 37528.702874
## iter  20 value 37493.191835
## final  value 37493.186277
## converged
## # weights:  121
## initial  value 39406.831931
## final  value 37490.621247
## converged
## # weights:  121
## initial  value 41700.906265
```

```
## iter  10 value 37495.359080
## iter  20 value 37491.020035
## iter  30 value 37490.960268
## iter  30 value 37490.960035
## iter  30 value 37490.959953
## final  value 37490.959953
## converged
## # weights:  121
## initial  value 40985.643403
## iter  10 value 37535.559474
## iter  20 value 37494.472641
## iter  30 value 37493.272158
## iter  40 value 37493.119599
## final  value 37493.065000
## converged
## # weights:  13
## initial  value 39252.332968
## final  value 37469.699701
## converged
## # weights:  13
## initial  value 39277.399150
## iter  10 value 37498.567486
## iter  20 value 37470.941435
## iter  30 value 37470.513618
## final  value 37470.485980
## converged
## # weights:  13
## initial  value 40795.431577
## iter  10 value 37476.666117
## final  value 37475.132321
## converged
## # weights:  25
## initial  value 38652.355783
## final  value 37469.699701
## converged
## # weights:  25
## initial  value 40449.212139
## iter  10 value 37508.770501
## iter  20 value 37471.281156
## iter  30 value 37470.386300
## final  value 37470.331271
## converged
## # weights:  25
## initial  value 41053.104522
## iter  10 value 37476.540715
## final  value 37474.165744
## converged
## # weights:  37
## initial  value 39674.504019
## final  value 37469.699701
```

```
## converged
## # weights:  37
## initial  value 38711.382196
## iter  10 value 37497.059612
## iter  20 value 37471.026013
## iter  30 value 37470.291189
## iter  40 value 37470.248178
## iter  40 value 37470.248027
## iter  40 value 37470.247951
## final  value 37470.247951
## converged
## # weights:  37
## initial  value 40226.883371
## iter  10 value 37481.295743
## iter  20 value 37473.624326
## final  value 37473.619437
## converged
## # weights:  49
## initial  value 40798.033194
## final  value 37469.699701
## converged
## # weights:  49
## initial  value 39352.289940
## iter  10 value 37518.601801
## iter  20 value 37471.341441
## iter  30 value 37470.283318
## iter  40 value 37470.193480
## final  value 37470.192650
## converged
## # weights:  49
## initial  value 38521.860443
## iter  10 value 37485.426197
## iter  20 value 37473.249245
## final  value 37473.248143
## converged
## # weights:  61
## initial  value 38574.481275
## final  value 37469.699701
## converged
## # weights:  61
## initial  value 40063.172902
## iter  10 value 37537.387276
## iter  20 value 37471.824161
## iter  30 value 37470.340019
## iter  40 value 37470.158252
## final  value 37470.152642
## converged
## # weights:  61
## initial  value 39203.214027
## iter  10 value 37490.648592
```

```
## iter  20 value 37472.976979
## final  value 37472.969080
## converged
## # weights:  73
## initial  value 40999.589428
## final  value 37469.699701
## converged
## # weights:  73
## initial  value 39093.197676
## iter  10 value 37527.333141
## iter  20 value 37471.674322
## iter  30 value 37470.202959
## iter  40 value 37470.123057
## final  value 37470.121557
## converged
## # weights:  73
## initial  value 38958.965483
## iter  10 value 37492.705346
## iter  20 value 37472.748906
## final  value 37472.746302
## converged
## # weights:  85
## initial  value 40050.762589
## final  value 37469.699701
## converged
## # weights:  85
## initial  value 40260.246154
## iter  10 value 37543.162655
## iter  20 value 37471.757515
## iter  30 value 37470.291864
## iter  40 value 37470.103744
## final  value 37470.095726
## converged
## # weights:  85
## initial  value 41311.158788
## iter  10 value 37491.397800
## iter  20 value 37472.579227
## final  value 37472.561388
## converged
## # weights:  97
## initial  value 41492.562298
## final  value 37469.699701
## converged
## # weights:  97
## initial  value 40061.569530
## iter  10 value 37491.813137
## iter  20 value 37470.213847
## iter  30 value 37470.078074
## final  value 37470.073901
## converged
```

```
## # weights:  97
## initial  value 38358.184962
## iter  10 value 37475.048622
## iter  20 value 37472.404347
## final  value 37472.403428
## converged
## # weights:  109
## initial  value 40040.249408
## final  value 37469.699701
## converged
## # weights:  109
## initial  value 41593.324626
## iter  10 value 37499.829727
## iter  20 value 37471.799043
## iter  30 value 37470.161216
## iter  40 value 37470.059545
## final  value 37470.054516
## converged
## # weights:  109
## initial  value 40095.282402
## iter  10 value 37501.476202
## iter  20 value 37472.278563
## final  value 37472.266246
## converged
## # weights:  121
## initial  value 40047.467554
## final  value 37469.699701
## converged
## # weights:  121
## initial  value 39000.484446
## iter  10 value 37474.578807
## iter  20 value 37470.065032
## iter  30 value 37470.038346
## iter  30 value 37470.038178
## iter  30 value 37470.038122
## final  value 37470.038122
## converged
## # weights:  121
## initial  value 39639.965174
## iter  10 value 37509.516889
## iter  20 value 37472.146919
## final  value 37472.144768
## converged
## # weights:  13
## initial  value 40286.009846
## final  value 37006.003034
## converged
## # weights:  13
## initial  value 39977.330990
## iter  10 value 37038.057084
```

```
## iter  20 value 37007.322358
## iter  30 value 37006.813299
## final  value 37006.787853
## converged
## # weights:  13
## initial  value 38784.929979
## iter  10 value 37012.014896
## final  value 37011.421347
## converged
## # weights:  25
## initial  value 39278.884992
## final  value 37006.003034
## converged
## # weights:  25
## initial  value 40013.677172
## iter  10 value 37047.536010
## iter  20 value 37007.791801
## iter  30 value 37006.687123
## iter  40 value 37006.634449
## final  value 37006.633617
## converged
## # weights:  25
## initial  value 38825.288315
## iter  10 value 37011.782565
## final  value 37010.456866
## converged
## # weights:  37
## initial  value 38954.429502
## final  value 37006.003034
## converged
## # weights:  37
## initial  value 39890.234836
## iter  10 value 37014.653558
## iter  20 value 37006.933888
## iter  30 value 37006.587490
## final  value 37006.550842
## converged
## # weights:  37
## initial  value 39334.586189
## iter  10 value 37012.987214
## final  value 37009.911941
## converged
## # weights:  49
## initial  value 39624.894617
## final  value 37006.003034
## converged
## # weights:  49
## initial  value 40191.505073
## iter  10 value 37053.346069
## iter  20 value 37007.666135
```

```
## iter  30 value 37006.550252
## iter  40 value 37006.495528
## iter  40 value 37006.495277
## iter  40 value 37006.495184
## final  value 37006.495184
## converged
## # weights:  49
## initial  value 39462.544041
## iter  10 value 37026.554809
## iter  20 value 37009.544873
## final  value 37009.541409
## converged
## # weights:  61
## initial  value 39208.751675
## final  value 37006.003034
## converged
## # weights:  61
## initial  value 38707.314695
## iter  10 value 37016.792496
## iter  20 value 37007.136361
## iter  30 value 37006.538971
## iter  40 value 37006.466677
## final  value 37006.455403
## converged
## # weights:  61
## initial  value 38504.780120
## iter  10 value 37024.161354
## iter  20 value 37009.266628
## final  value 37009.263097
## converged
## # weights:  73
## initial  value 38036.511940
## final  value 37006.003034
## converged
## # weights:  73
## initial  value 38793.625807
## iter  10 value 37020.081224
## iter  20 value 37006.581219
## iter  30 value 37006.429618
## final  value 37006.423252
## converged
## # weights:  73
## initial  value 38508.085887
## iter  10 value 37025.791170
## iter  20 value 37009.042256
## final  value 37009.040972
## converged
## # weights:  85
## initial  value 38214.525822
## final  value 37006.003034
```

```
## converged
## # weights:  85
## initial  value 39381.879552
## iter  10 value 37063.601284
## iter  20 value 37007.786412
## iter  30 value 37006.427768
## iter  40 value 37006.399474
## final  value 37006.397496
## converged
## # weights:  85
## initial  value 38579.623904
## iter  10 value 37032.548782
## iter  20 value 37008.862436
## final  value 37008.856362
## converged
## # weights:  97
## initial  value 38787.509001
## final  value 37006.003034
## converged
## # weights:  97
## initial  value 38955.715892
## iter  10 value 37074.108710
## iter  20 value 37008.367331
## iter  30 value 37006.558676
## iter  40 value 37006.383076
## final  value 37006.376064
## converged
## # weights:  97
## initial  value 39593.706248
## iter  10 value 37029.901973
## iter  20 value 37008.700989
## final  value 37008.699100
## converged
## # weights:  109
## initial  value 38952.899553
## final  value 37006.003034
## converged
## # weights:  109
## initial  value 39354.575562
## iter  10 value 37010.929820
## iter  20 value 37006.369446
## final  value 37006.359197
## converged
## # weights:  109
## initial  value 40398.926139
## iter  10 value 37038.087161
## iter  20 value 37008.568962
## final  value 37008.561927
## converged
## # weights:  121
```

```
## initial  value 38826.055127
## final  value 37006.003034
## converged
## # weights:  121
## initial  value 38993.864027
## iter  10 value 37076.817055
## iter  20 value 37008.593699
## iter  30 value 37006.424540
## final  value 37006.341978
## converged
## # weights:  121
## initial  value 40206.124986
## iter  10 value 37044.704836
## iter  20 value 37008.443987
## final  value 37008.441046
## converged
## # weights:  13
## initial  value 39765.355154
## final  value 36977.686487
## converged
## # weights:  13
## initial  value 40353.960480
## iter  10 value 37003.271994
## iter  20 value 36979.082909
## iter  30 value 36978.530270
## final  value 36978.471573
## converged
## # weights:  13
## initial  value 40148.611022
## iter  10 value 36984.163559
## final  value 36983.107629
## converged
## # weights:  25
## initial  value 39297.175841
## final  value 36977.686487
## converged
## # weights:  25
## initial  value 40057.750825
## iter  10 value 37014.581765
## iter  20 value 36979.102924
## iter  30 value 36978.382501
## iter  40 value 36978.319636
## final  value 36978.317265
## converged
## # weights:  25
## initial  value 39921.008803
## iter  10 value 36985.408092
## iter  20 value 36982.143361
## final  value 36982.142731
## converged
```

```
## # weights:  37
## initial  value 38878.274158
## final  value 36977.686487
## converged
## # weights:  37
## initial  value 38594.437661
## iter  10 value 37010.736759
## iter  20 value 36979.147497
## iter  30 value 36978.253480
## final  value 36978.235307
## converged
## # weights:  37
## initial  value 40077.056680
## iter  10 value 36983.657180
## final  value 36981.597471
## converged
## # weights:  49
## initial  value 39161.632938
## final  value 36977.686487
## converged
## # weights:  49
## initial  value 39350.280229
## iter  10 value 37030.891645
## iter  20 value 36979.123184
## iter  30 value 36978.254612
## iter  40 value 36978.181115
## final  value 36978.178732
## converged
## # weights:  49
## initial  value 39675.234453
## iter  10 value 36997.277192
## iter  20 value 36981.227539
## final  value 36981.226918
## converged
## # weights:  61
## initial  value 38923.300678
## final  value 36977.686487
## converged
## # weights:  61
## initial  value 38794.102549
## iter  10 value 37038.115452
## iter  20 value 36979.934240
## iter  30 value 36978.336977
## iter  40 value 36978.150790
## final  value 36978.139062
## converged
## # weights:  61
## initial  value 39703.293848
## iter  10 value 37002.640793
## iter  20 value 36981.020378
```

```
## final  value 36980.948590
## converged
## # weights:  73
## initial  value 40028.611696
## final  value 36977.686487
## converged
## # weights:  73
## initial  value 38523.583296
## iter  10 value 37028.710307
## iter  20 value 36979.627666
## iter  30 value 36978.182936
## iter  40 value 36978.111620
## final  value 36978.108505
## converged
## # weights:  73
## initial  value 38280.556278
## iter  10 value 36999.364142
## iter  20 value 36980.728048
## final  value 36980.726228
## converged
## # weights:  85
## initial  value 39189.496951
## final  value 36977.686487
## converged
## # weights:  85
## initial  value 39831.786326
## iter  10 value 36997.185650
## iter  20 value 36978.228923
## iter  30 value 36978.084724
## final  value 36978.082473
## converged
## # weights:  85
## initial  value 39246.901000
## iter  10 value 37007.197234
## iter  20 value 36980.545957
## final  value 36980.541613
## converged
## # weights:  97
## initial  value 38055.465653
## final  value 36977.686487
## converged
## # weights:  97
## initial  value 40231.208091
## iter  10 value 37000.417071
## iter  20 value 36978.738807
## iter  30 value 36978.065968
## final  value 36978.061288
## converged
## # weights:  97
## initial  value 40521.367431
```

```
## iter  10 value 37002.000047
## iter  20 value 36980.386103
## final  value 36980.384102
## converged
## # weights:  109
## initial  value 39158.774790
## final  value 36977.686487
## converged
## # weights:  109
## initial  value 40109.118181
## iter  10 value 37052.390499
## iter  20 value 36980.338890
## iter  30 value 36978.139890
## iter  40 value 36978.045145
## final  value 36978.040668
## converged
## # weights:  109
## initial  value 38600.111484
## iter  10 value 37010.113029
## iter  20 value 36980.248897
## final  value 36980.247085
## converged
## # weights:  121
## initial  value 40022.558413
## final  value 36977.686487
## converged
## # weights:  121
## initial  value 38722.777654
## iter  10 value 37052.108008
## iter  20 value 36980.268782
## iter  30 value 36978.192792
## iter  40 value 36978.028546
## final  value 36978.024116
## converged
## # weights:  121
## initial  value 38641.589213
## iter  10 value 36982.246704
## iter  20 value 36980.126119
## iter  20 value 36980.125937
## iter  20 value 36980.125861
## final  value 36980.125861
## converged
## # weights:  13
## initial  value 39813.464072
## final  value 36786.167527
## converged
## # weights:  13
## initial  value 38667.574067
## iter  10 value 36816.420767
## iter  20 value 36787.556913
```

```
## iter  30 value 36786.972376
## final  value 36786.951986
## converged
## # weights:  13
## initial  value 39743.064694
## iter  10 value 36792.558182
## final  value 36791.582791
## converged
## # weights:  25
## initial  value 38682.429772
## final  value 36786.167527
## converged
## # weights:  25
## initial  value 39899.230260
## iter  10 value 36825.224795
## iter  20 value 36787.721184
## iter  30 value 36786.886911
## iter  40 value 36786.800052
## final  value 36786.798801
## converged
## # weights:  25
## initial  value 39995.464143
## iter  10 value 36791.992517
## iter  20 value 36790.619358
## iter  20 value 36790.619142
## iter  20 value 36790.619047
## final  value 36790.619047
## converged
## # weights:  37
## initial  value 38361.213839
## final  value 36786.167527
## converged
## # weights:  37
## initial  value 38943.707840
## iter  10 value 36834.856936
## iter  20 value 36788.205402
## iter  30 value 36786.814956
## iter  40 value 36786.715554
## final  value 36786.714497
## converged
## # weights:  37
## initial  value 38310.929632
## iter  10 value 36801.344372
## iter  20 value 36790.074479
## iter  20 value 36790.074221
## iter  20 value 36790.074213
## final  value 36790.074213
## converged
## # weights:  49
## initial  value 39674.575747
```

```
## final  value 36786.167527
## converged
## # weights:  49
## initial  value 39587.197708
## iter  10 value 36833.739899
## iter  20 value 36787.732600
## iter  30 value 36786.689342
## iter  40 value 36786.659230
## iter  40 value 36786.659071
## iter  40 value 36786.659024
## final  value 36786.659024
## converged
## # weights:  49
## initial  value 38808.988780
## iter  10 value 36803.487314
## iter  20 value 36789.704501
## final  value 36789.703946
## converged
## # weights:  61
## initial  value 38651.707324
## final  value 36786.167527
## converged
## # weights:  61
## initial  value 39194.065724
## iter  10 value 36840.648383
## iter  20 value 36787.938143
## iter  30 value 36786.676303
## iter  40 value 36786.621252
## final  value 36786.619126
## converged
## # weights:  61
## initial  value 40192.562406
## iter  10 value 36802.034665
## iter  20 value 36789.426860
## final  value 36789.425786
## converged
## # weights:  73
## initial  value 38951.589204
## final  value 36786.167527
## converged
## # weights:  73
## initial  value 39313.075012
## iter  10 value 36795.028427
## iter  20 value 36786.652403
## iter  30 value 36786.590481
## final  value 36786.587139
## converged
## # weights:  73
## initial  value 39037.081603
## iter  10 value 36809.224590
```

```
## iter  20 value 36789.205541
## final  value 36789.203846
## converged
## # weights:  85
## initial  value 37800.080072
## final  value 36786.167527
## converged
## # weights:  85
## initial  value 38905.123366
## iter  10 value 36800.066823
## iter  20 value 36786.706895
## iter  30 value 36786.563772
## final  value 36786.562848
## converged
## # weights:  85
## initial  value 39141.516438
## iter  10 value 36812.810280
## iter  20 value 36789.022985
## final  value 36789.019411
## converged
## # weights:  97
## initial  value 39965.795123
## final  value 36786.167527
## converged
## # weights:  97
## initial  value 39813.386359
## iter  10 value 36797.958658
## iter  20 value 36786.643120
## iter  30 value 36786.543393
## final  value 36786.539771
## converged
## # weights:  97
## initial  value 38910.645984
## iter  10 value 36816.067874
## iter  20 value 36788.865955
## final  value 36788.861977
## converged
## # weights:  109
## initial  value 39730.063941
## final  value 36786.167527
## converged
## # weights:  109
## initial  value 39063.628944
## iter  10 value 36796.865156
## iter  20 value 36786.640664
## iter  30 value 36786.529416
## final  value 36786.523050
## converged
## # weights:  109
## initial  value 39339.128035
```

```
## iter  10 value 36819.928149
## iter  20 value 36788.729370
## final  value 36788.725166
## converged
## # weights:  121
## initial  value 38276.309668
## final  value 36786.167527
## converged
## # weights:  121
## initial  value 40586.493190
## iter  10 value 36835.893008
## iter  20 value 36788.654335
## iter  30 value 36786.615387
## iter  40 value 36786.509287
## final  value 36786.505235
## converged
## # weights:  121
## initial  value 40211.189058
## iter  10 value 36830.465169
## iter  20 value 36789.222929
## final  value 36788.604070
## converged
## # weights:  13
## initial  value 40126.233458
## final  value 37167.265962
## converged
## # weights:  13
## initial  value 38591.017144
## iter  10 value 37190.842149
## iter  20 value 37168.670883
## iter  30 value 37168.058677
## final  value 37168.052173
## converged
## # weights:  13
## initial  value 40387.208549
## iter  10 value 37173.332637
## final  value 37172.689159
## converged
## # weights:  25
## initial  value 39067.815065
## final  value 37167.265962
## converged
## # weights:  25
## initial  value 39876.191784
## iter  10 value 37208.200872
## iter  20 value 37168.921111
## iter  30 value 37168.007367
## iter  40 value 37167.897369
## final  value 37167.896545
## converged
```

```
## # weights:  25
## initial  value 40437.341424
## iter  10 value 37174.548596
## iter  20 value 37171.738181
## final  value 37171.723862
## converged
## # weights:  37
## initial  value 39460.646674
## final  value 37167.265962
## converged
## # weights:  37
## initial  value 40123.378986
## iter  10 value 37208.034377
## iter  20 value 37168.735802
## iter  30 value 37167.867305
## iter  40 value 37167.814224
## final  value 37167.813600
## converged
## # weights:  37
## initial  value 39266.322216
## iter  10 value 37172.343493
## final  value 37171.178414
## converged
## # weights:  49
## initial  value 39813.241372
## final  value 37167.265962
## converged
## # weights:  49
## initial  value 40614.512605
## iter  10 value 37207.521021
## iter  20 value 37168.980386
## iter  30 value 37167.844706
## iter  40 value 37167.760805
## final  value 37167.758573
## converged
## # weights:  49
## initial  value 39320.072710
## iter  10 value 37172.775239
## final  value 37170.807741
## converged
## # weights:  61
## initial  value 39774.653980
## final  value 37167.265962
## converged
## # weights:  61
## initial  value 40004.236505
## iter  10 value 37226.551805
## iter  20 value 37168.986896
## iter  30 value 37167.773025
## iter  40 value 37167.720167
```

```
## final  value 37167.718677
## converged
## # weights:  61
## initial  value 39533.348381
## iter  10 value 37188.302447
## iter  20 value 37170.529690
## iter  20 value 37170.529328
## iter  20 value 37170.529304
## final  value 37170.529304
## converged
## # weights:  73
## initial  value 39694.485255
## final  value 37167.265962
## converged
## # weights:  73
## initial  value 38766.309633
## iter  10 value 37219.343587
## iter  20 value 37168.922341
## iter  30 value 37167.750773
## iter  40 value 37167.688091
## final  value 37167.686834
## converged
## # weights:  73
## initial  value 39517.402727
## iter  10 value 37192.370951
## iter  20 value 37170.313895
## final  value 37170.306906
## converged
## # weights:  85
## initial  value 40382.174054
## final  value 37167.265962
## converged
## # weights:  85
## initial  value 38280.350698
## iter  10 value 37176.245343
## iter  20 value 37167.830066
## iter  30 value 37167.664565
## final  value 37167.661358
## converged
## # weights:  85
## initial  value 40090.229297
## iter  10 value 37199.993222
## iter  20 value 37170.132083
## final  value 37170.122007
## converged
## # weights:  97
## initial  value 39626.286069
## final  value 37167.265962
## converged
## # weights:  97
```

```
## initial  value 40730.891553
## iter  10 value 37220.245256
## iter  20 value 37169.793537
## iter  30 value 37167.727727
## iter  40 value 37167.640879
## final  value 37167.639529
## converged
## # weights:  97
## initial  value 38607.436851
## iter  10 value 37196.396360
## iter  20 value 37169.968607
## final  value 37169.964481
## converged
## # weights:  109
## initial  value 38917.897506
## final  value 37167.265962
## converged
## # weights:  109
## initial  value 39334.301789
## iter  10 value 37252.093451
## iter  20 value 37169.543016
## iter  30 value 37167.794098
## iter  40 value 37167.624303
## final  value 37167.620447
## converged
## # weights:  109
## initial  value 38576.121036
## iter  10 value 37198.979991
## iter  20 value 37169.830768
## final  value 37169.827427
## converged
## # weights:  121
## initial  value 39593.290251
## final  value 37167.265962
## converged
## # weights:  121
## initial  value 40118.128790
## iter  10 value 37246.225690
## iter  20 value 37169.976027
## iter  30 value 37167.785826
## iter  40 value 37167.610397
## final  value 37167.604028
## converged
## # weights:  121
## initial  value 38489.352535
## iter  10 value 37197.971742
## iter  20 value 37170.012897
## final  value 37169.706096
## converged
## # weights:  13
```

```
## initial  value 39401.094402
## final  value 36970.828793
## converged
## # weights:  13
## initial  value 40393.179677
## iter  10 value 36993.810159
## iter  20 value 36972.230660
## iter  30 value 36971.625829
## final  value 36971.614102
## converged
## # weights:  13
## initial  value 38817.590933
## iter  10 value 36976.732808
## final  value 36976.250082
## converged
## # weights:  25
## initial  value 38241.514952
## final  value 36970.828793
## converged
## # weights:  25
## initial  value 39260.573702
## iter  10 value 37011.934238
## iter  20 value 36972.285547
## iter  30 value 36971.498426
## final  value 36971.460685
## converged
## # weights:  25
## initial  value 39040.276856
## iter  10 value 36981.209966
## iter  20 value 36975.294818
## final  value 36975.285283
## converged
## # weights:  37
## initial  value 39659.301581
## final  value 36970.828793
## converged
## # weights:  37
## initial  value 40115.342362
## iter  10 value 37014.072196
## iter  20 value 36972.469744
## iter  30 value 36971.428115
## iter  40 value 36971.377161
## iter  40 value 36971.376866
## iter  40 value 36971.376775
## final  value 36971.376775
## converged
## # weights:  37
## initial  value 39113.040742
## iter  10 value 36977.602101
## final  value 36974.739942
```

```
## converged
## # weights:  49
## initial  value 39642.170546
## final  value 36970.828793
## converged
## # weights:  49
## initial  value 39588.841570
## iter  10 value 36985.994520
## iter  20 value 36974.306195
## iter  30 value 36971.500539
## iter  40 value 36971.330414
## final  value 36971.320993
## converged
## # weights:  49
## initial  value 39894.559569
## iter  10 value 36981.951464
## iter  20 value 36974.369959
## iter  20 value 36974.369602
## iter  20 value 36974.369511
## final  value 36974.369511
## converged
## # weights:  61
## initial  value 39523.363236
## final  value 36970.828793
## converged
## # weights:  61
## initial  value 39465.873022
## iter  10 value 36986.411335
## iter  20 value 36971.639664
## iter  30 value 36971.285819
## final  value 36971.280675
## converged
## # weights:  61
## initial  value 38713.716270
## iter  10 value 36991.147760
## iter  20 value 36974.092410
## final  value 36974.091003
## converged
## # weights:  73
## initial  value 39078.910362
## final  value 36970.828793
## converged
## # weights:  73
## initial  value 40527.688495
## iter  10 value 37012.903135
## iter  20 value 36972.525824
## iter  30 value 36971.315337
## iter  40 value 36971.253005
## final  value 36971.249657
## converged
```

```
## # weights:  73
## initial  value 39868.634859
## iter  10 value 36994.006123
## iter  20 value 36973.873532
## final  value 36973.868635
## converged
## # weights:  85
## initial  value 40220.745048
## final  value 36970.828793
## converged
## # weights:  85
## initial  value 38812.114473
## iter  10 value 37028.855278
## iter  20 value 36972.771370
## iter  30 value 36971.295545
## iter  40 value 36971.226680
## final  value 36971.223610
## converged
## # weights:  85
## initial  value 39201.443230
## iter  10 value 36997.092314
## iter  20 value 36973.684453
## iter  20 value 36973.684207
## iter  20 value 36973.684136
## final  value 36973.684136
## converged
## # weights:  97
## initial  value 38840.935092
## final  value 36970.828793
## converged
## # weights:  97
## initial  value 38263.693360
## iter  10 value 37015.477562
## iter  20 value 36972.523786
## iter  30 value 36971.244076
## iter  40 value 36971.202620
## iter  40 value 36971.202273
## iter  40 value 36971.202194
## final  value 36971.202194
## converged
## # weights:  97
## initial  value 40195.125006
## iter  10 value 37001.308571
## iter  20 value 36973.528823
## final  value 36973.526500
## converged
## # weights:  109
## initial  value 38687.316326
## final  value 36970.828793
## converged
```

```
## # weights:  109
## initial  value 39498.366722
## iter  10 value 36988.449683
## iter  20 value 36971.320082
## iter  30 value 36971.185952
## final  value 36971.183453
## converged
## # weights:  109
## initial  value 41175.719965
## iter  10 value 36976.447626
## iter  20 value 36973.389647
## iter  20 value 36973.389449
## iter  20 value 36973.389428
## final  value 36973.389428
## converged
## # weights:  121
## initial  value 39188.708676
## final  value 36970.828793
## converged
## # weights:  121
## initial  value 40538.543984
## iter  10 value 36981.203810
## iter  20 value 36971.969725
## iter  30 value 36971.196056
## final  value 36971.167187
## converged
## # weights:  121
## initial  value 40312.372582
## iter  10 value 37005.609781
## iter  20 value 36973.274540
## final  value 36973.268342
## converged
## # weights:  13
## initial  value 40172.551267
## final  value 37293.818567
## converged
## # weights:  13
## initial  value 39255.283390
## iter  10 value 37328.567121
## iter  20 value 37295.483435
## iter  30 value 37294.724040
## iter  40 value 37294.605464
## final  value 37294.603890
## converged
## # weights:  13
## initial  value 39985.851189
## iter  10 value 37299.763875
## final  value 37299.243489
## converged
## # weights:  25
```

```
## initial  value 40043.102247
## final  value 37293.818567
## converged
## # weights:  25
## initial  value 40030.813246
## iter  10 value 37340.488048
## iter  20 value 37295.559212
## iter  30 value 37294.529643
## final  value 37294.449739
## converged
## # weights:  25
## initial  value 39715.207368
## iter  10 value 37304.828266
## iter  20 value 37298.278776
## final  value 37298.277889
## converged
## # weights:  37
## initial  value 40458.427972
## final  value 37293.818567
## converged
## # weights:  37
## initial  value 39643.504991
## iter  10 value 37341.641415
## iter  20 value 37295.484634
## iter  30 value 37294.443199
## iter  40 value 37294.368866
## final  value 37294.366383
## converged
## # weights:  37
## initial  value 38912.297747
## iter  10 value 37302.068150
## iter  20 value 37297.733035
## final  value 37297.732294
## converged
## # weights:  49
## initial  value 40930.777986
## final  value 37293.818567
## converged
## # weights:  49
## initial  value 40149.270264
## iter  10 value 37340.916377
## iter  20 value 37295.596889
## iter  30 value 37294.382297
## iter  40 value 37294.315900
## final  value 37294.311585
## converged
## # weights:  49
## initial  value 40043.719037
## iter  10 value 37312.663281
## iter  20 value 37297.361717
```

```
## iter  20 value 37297.361522
## iter  20 value 37297.361446
## final  value 37297.361446
## converged
## # weights:  61
## initial  value 40521.464504
## final  value 37293.818567
## converged
## # weights:  61
## initial  value 40653.129136
## iter  10 value 37301.406890
## iter  20 value 37294.506412
## iter  30 value 37294.294118
## final  value 37294.272074
## converged
## # weights:  61
## initial  value 38908.030037
## iter  10 value 37311.570534
## iter  20 value 37297.082922
## iter  20 value 37297.082736
## iter  20 value 37297.082723
## final  value 37297.082723
## converged
## # weights:  73
## initial  value 38724.904371
## final  value 37293.818567
## converged
## # weights:  73
## initial  value 38561.420038
## iter  10 value 37332.507581
## iter  20 value 37295.535452
## iter  30 value 37294.297972
## final  value 37294.241019
## converged
## # weights:  73
## initial  value 40518.093795
## iter  10 value 37315.830590
## iter  20 value 37296.867628
## final  value 37296.860276
## converged
## # weights:  85
## initial  value 40655.901018
## final  value 37293.818567
## converged
## # weights:  85
## initial  value 40189.408662
## iter  10 value 37359.610112
## iter  20 value 37296.198199
## iter  30 value 37294.382175
## iter  40 value 37294.216536
```

```
## final  value 37294.213922
## converged
## # weights:  85
## initial  value 39291.760386
## iter  10 value 37322.459002
## iter  20 value 37296.681334
## final  value 37296.675694
## converged
## # weights:  97
## initial  value 39916.902053
## final  value 37293.818567
## converged
## # weights:  97
## initial  value 40895.577071
## iter  10 value 37311.300435
## iter  20 value 37294.503219
## iter  30 value 37294.200656
## final  value 37294.192656
## converged
## # weights:  97
## initial  value 39849.947745
## iter  10 value 37324.095685
## iter  20 value 37296.520221
## final  value 37296.517915
## converged
## # weights:  109
## initial  value 40582.712632
## final  value 37293.818567
## converged
## # weights:  109
## initial  value 39808.647958
## iter  10 value 37315.292013
## iter  20 value 37295.244420
## iter  30 value 37294.269635
## iter  40 value 37294.176465
## final  value 37294.172766
## converged
## # weights:  109
## initial  value 40589.422374
## iter  10 value 37332.272954
## iter  20 value 37296.385915
## final  value 37296.380721
## converged
## # weights:  121
## initial  value 40274.516296
## final  value 37293.818567
## converged
## # weights:  121
## initial  value 38028.224220
## iter  10 value 37321.402616
```

```
## iter  20 value 37296.110888
## iter  30 value 37294.205951
## final  value 37294.156670
## converged
## # weights:  121
## initial  value 41303.274128
## iter  10 value 37297.536995
## final  value 37296.259606
## converged
## # weights:  13
## initial  value 40505.092099
## final  value 37021.959838
## converged
## # weights:  13
## initial  value 39992.245509
## iter  10 value 37056.056818
## iter  20 value 37023.465973
## iter  30 value 37022.799154
## final  value 37022.745388
## converged
## # weights:  13
## initial  value 38745.855277
## iter  10 value 37027.551512
## final  value 37027.384399
## converged
## # weights:  25
## initial  value 38715.061567
## final  value 37021.959838
## converged
## # weights:  25
## initial  value 40212.917482
## iter  10 value 37054.943928
## iter  20 value 37023.395486
## iter  30 value 37022.640069
## final  value 37022.591035
## converged
## # weights:  25
## initial  value 39959.260897
## iter  10 value 37026.619478
## final  value 37026.419572
## converged
## # weights:  37
## initial  value 38969.947546
## final  value 37021.959838
## converged
## # weights:  37
## initial  value 38423.304769
## iter  10 value 37051.502061
## iter  20 value 37023.430073
## iter  30 value 37022.546643
```

```
## iter  40 value 37022.507852
## iter  40 value 37022.507642
## iter  40 value 37022.507568
## final  value 37022.507568
## converged
## # weights:  37
## initial  value 39222.502808
## iter  10 value 37027.368102
## final  value 37025.873904
## converged
## # weights:  49
## initial  value 40629.086131
## final  value 37021.959838
## converged
## # weights:  49
## initial  value 40151.588697
## iter  10 value 37031.477657
## iter  20 value 37022.862843
## iter  30 value 37022.478066
## final  value 37022.452146
## converged
## # weights:  49
## initial  value 40289.858225
## iter  10 value 37028.216532
## final  value 37025.503244
## converged
## # weights:  61
## initial  value 40669.835637
## final  value 37021.959838
## converged
## # weights:  61
## initial  value 40438.630104
## iter  10 value 37064.823308
## iter  20 value 37023.812838
## iter  30 value 37022.487538
## iter  40 value 37022.414483
## final  value 37022.412990
## converged
## # weights:  61
## initial  value 40635.273300
## iter  10 value 37040.337249
## iter  20 value 37025.235037
## final  value 37025.224511
## converged
## # weights:  73
## initial  value 39373.304348
## final  value 37021.959838
## converged
## # weights:  73
## initial  value 38737.628255
```

```
## iter  10 value 37077.807319
## iter  20 value 37024.412736
## iter  30 value 37022.565869
## iter  40 value 37022.388951
## final  value 37022.381372
## converged
## # weights:  73
## initial  value 38687.923926
## iter  10 value 37047.283009
## iter  20 value 37025.006945
## final  value 37025.002043
## converged
## # weights:  85
## initial  value 38683.154326
## final  value 37021.959838
## converged
## # weights:  85
## initial  value 39641.859087
## iter  10 value 37094.049397
## iter  20 value 37024.055572
## iter  30 value 37022.433912
## iter  40 value 37022.359383
## final  value 37022.355137
## converged
## # weights:  85
## initial  value 38469.045089
## iter  10 value 37026.559177
## iter  20 value 37024.817427
## iter  20 value 37024.817303
## iter  20 value 37024.817276
## final  value 37024.817276
## converged
## # weights:  97
## initial  value 40983.472396
## final  value 37021.959838
## converged
## # weights:  97
## initial  value 39227.305909
## iter  10 value 37031.308767
## iter  20 value 37022.389410
## final  value 37022.333582
## converged
## # weights:  97
## initial  value 39996.384621
## iter  10 value 37053.697872
## iter  20 value 37024.682821
## final  value 37024.659667
## converged
## # weights:  109
## initial  value 39614.271775
```

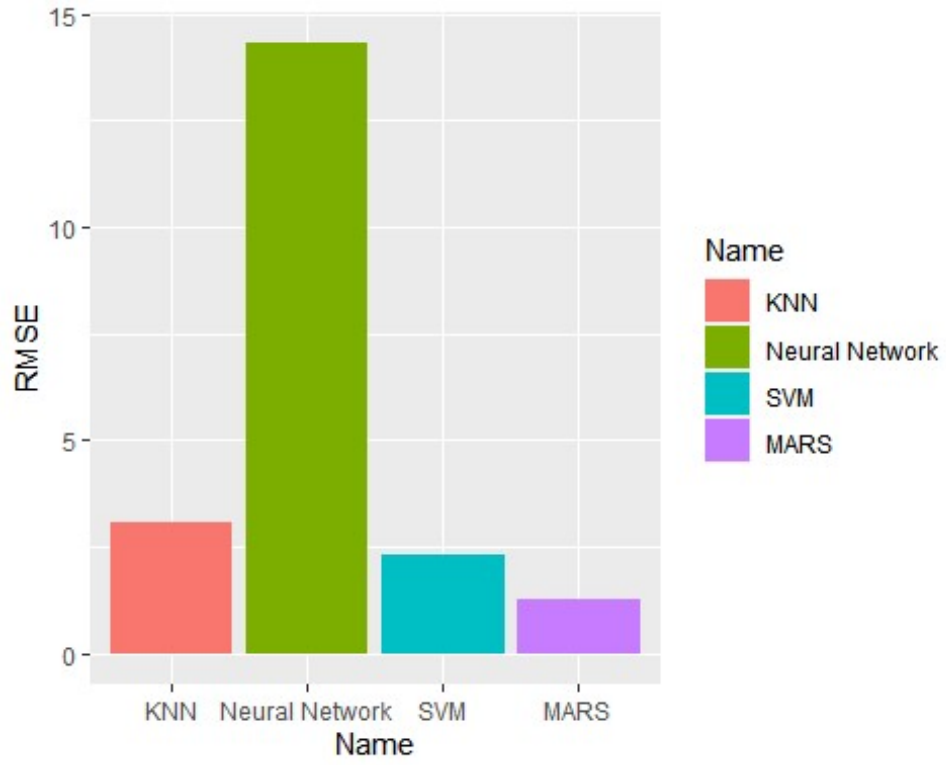
```
## final  value 37021.959838
## converged
## # weights:  109
## initial  value 39141.835138
## iter  10 value 37031.053635
## iter  20 value 37022.407148
## iter  30 value 37022.315982
## final  value 37022.314669
## converged
## # weights:  109
## initial  value 38899.252578
## iter  10 value 37055.718966
## iter  20 value 37024.525133
## final  value 37024.522494
## converged
## # weights:  121
## initial  value 37837.847621
## final  value 37021.959838
## converged
## # weights:  121
## initial  value 40414.329938
## iter  10 value 37042.812500
## iter  20 value 37022.505146
## iter  30 value 37022.299327
## final  value 37022.298061
## converged
## # weights:  121
## initial  value 39516.676869
## iter  10 value 37065.227876
## iter  20 value 37024.403656
## final  value 37024.401344
## converged

## Warning in nominalTrainWorkflow(x = x, y = y, wts = weights, info =
trainInfo, :
## There were missing values in resampled performance measures.

## # weights:  13
## initial  value 43292.015220
## final  value 41228.983635
## converged
##     RMSE Rsquared      MAE
## 14.31734       NA 13.40039
```

SVM Performace

```
library(mlbench)
svm_rst = evaluation('svmRadial')

##      RMSE  Rsquared       MAE
## 2.3206365 0.7888815 1.7814575
```

MARS Performance

```
marsGrid = expand.grid(degree = 1:2, nprune = 2:15)
mars_rst = evaluation('earth', marsGrid)

##      RMSE  Rsquared       MAE
## 1.2730567 0.9365257 1.0126842

df_performance = rbind(data.frame(Name = 'KNN', RMSE = knn_rst[1]),
data.frame(Name= 'Neural Network', RMSE = net_rst[1]) , data.frame(Name =
'SVM', RMSE =svm_rst[1]), data.frame(Name = 'MARS', RMSE = mars_rst[1]))
ggplot() +
  geom_bar(data = df_performance, aes(x = Name, y = RMSE, fill=Name),
stat="identity")
```



Which models appear to give the best performance?

As we can see from above graph, The MARS model outpreform amnong all the other models.The model performance metric RMSE gives minimum result for MARS model.

Does MARS select informative predictors (those named X1-X5)

```
marsGrid = expand.grid(degree = 1:2, nprune = 2:15)
MARSModel = train(x = trainingData$x, y = trainingData$y, method = 'earth',
tuneGrid = marsGrid, preProcess = c('center', 'scale'), trControl =
trainControl(method='cv'))
varImp(MARSModel)
```

```
## earth variable importance
##
##    Overall
## X4  100.00
## X1   63.04
## X2   40.92
## X5   18.90
## X3    0.00
```

The graph at above shows ranking /feature importance results for variables X1-X5.As we can review X4 (100) is highest ranked feaure,next X1 (63.04), X2 (40.92), X5 (18.90) nad X3 (0.00)

7.5

Exercise 6.3 describes data for a chemical manufacturing process. Use the same data imputation, data splitting, and pre-processing steps as before and train several nonlinear regression models.

Prepare Data

```
set.seed(42)
data(ChemicalManufacturingProcess)
chem_data <- ChemicalManufacturingProcess
chem_imputed <- preProcess(chem_data[,2:ncol(chem_data)],
method=c('knnImpute')) # KNN imputation for NaN values
chem_data <- cbind(chem_data$Yield,predict(chem_imputed,
chem_data[,2:ncol(chem_data)]))
colnames(chem_data)[1] <- "Yield"
#split  train and test data into 70/30
n <-  floor(0.70 * nrow(chem_data))
idx <- sample(seq_len(nrow(chem_data)), size = n)
train <- chem_data[idx, ]
test <- chem_data[-idx, ]
```

Model Evaluation Function

```
evaluation = function(method, gridSearch = NULL)
{
  Model = train(x = train[,-1], y = train$Yield, method = method, tuneGrid =
gridSearch, preProcess = c('center', 'scale'), trControl =
trainControl(method='cv'))
  Pred = predict(Model, newdata = test[,-1])
  performance = postResample(Pred,  test$Yield)
  print(performance)
}
```

KNN Model Performace

```
knn_rst = evaluation('knn')
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
```

```
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

##      RMSE  Rsquared       MAE
## 1.2758531 0.5315532 1.0397736
```

Neural Net Perforance

```
nnetGrid = expand.grid(decay = c(0,0.01, .1), size = c(1:10))
net_rst = evaluation('nnet', nnetGrid)

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 173118.109867
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 172189.589199
## iter  10 value 168855.153030
## iter  20 value 168759.909577
## iter  30 value 168758.873373
## iter  40 value 168758.678876
## iter  50 value 168758.604262
```

```
## iter  50 value 168758.603571
## iter  50 value 168758.603149
## final  value 168758.603149
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174121.816489
## iter  10 value 168766.931172
## iter  20 value 168763.768631
## final  value 168763.761623
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 171857.485722
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 172855.878908
## iter  10 value 168899.789614
## iter  20 value 168761.719301
## iter  30 value 168758.882932
## iter  40 value 168758.438574
## final  value 168758.431709
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 173188.131277
## iter  10 value 168801.185678
## iter  20 value 168763.289577
## final  value 168762.668826
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  178
## initial  value 172294.107455
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 174757.021748
## iter  10 value 168772.567242
## iter  20 value 168760.238218
## iter  30 value 168758.576582
## iter  40 value 168758.351782
## final  value 168758.339513
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 172457.442836
## iter  10 value 168811.388259
## iter  20 value 168762.615862
## final  value 168762.057168
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 172669.020385
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 172876.974877
## iter  10 value 168781.035495
## iter  20 value 168758.517660
## iter  30 value 168758.303060
## final  value 168758.278613
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 173248.247390
## iter  10 value 168833.095976
## iter  20 value 168762.347011
## iter  30 value 168761.650266
## iter  30 value 168761.649282
## iter  30 value 168761.649282
## final  value 168761.649282
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 175183.095710
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 171107.258886
## iter  10 value 168758.739951
## iter  20 value 168758.246948
## final  value 168758.238414
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 173248.933989
## iter  10 value 168845.426869
## iter  20 value 168761.795275
## final  value 168761.337711
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 172721.863771
```

```
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 171695.926521
## iter  10 value 168758.447730
## iter  20 value 168758.211935
## final  value 168758.207666
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 171553.038308
## iter  10 value 168765.220983
## iter  20 value 168761.106493
## final  value 168761.089453
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 172075.459248
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 172142.101899
## iter  10 value 168758.375438
## final  value 168758.180176
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 171185.953724
## iter  10 value 168763.701453
## iter  20 value 168760.891291
```

```
## final  value 168760.885985
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 171298.946071
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 172016.392931
## iter  10 value 168758.401317
## iter  20 value 168758.154685
## iter  20 value 168758.153425
## iter  20 value 168758.152935
## final  value 168758.152935
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 172026.609408
## iter  10 value 168763.215748
## iter  20 value 168760.738114
## final  value 168760.712698
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 173154.148571
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 174924.565950
## iter  10 value 168781.833398
```

```
## iter  20 value 168758.497285
## iter  30 value 168758.139306
## final  value 168758.132212
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175221.752435
## iter  10 value 168809.698253
## iter  20 value 168760.755980
## final  value 168760.579984
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173984.763847
## final  value 168757.744700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 170219.516154
## iter  10 value 168759.304899
## iter  20 value 168758.118713
## final  value 168758.113767
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 175537.906038
## iter  10 value 168812.029793
## iter  20 value 168760.467638
## final  value 168760.429790
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  60
## initial  value 174329.319363
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174125.089621
## iter  10 value 169543.510683
## iter  20 value 169445.957600
## iter  30 value 169444.912816
## final  value 169444.739845
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 172979.665233
## iter  10 value 169469.525660
## iter  20 value 169449.944458
## final  value 169449.897525
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175527.304915
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175003.704976
## iter  10 value 169558.814771
## iter  20 value 169447.140660
## iter  30 value 169444.966345
## iter  40 value 169444.676620
## final  value 169444.566255
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 173514.093690
## iter  10 value 169483.795585
## iter  20 value 169448.863639
## final  value 169448.803246
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173413.983466
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 175161.112267
## iter  10 value 169481.965806
## iter  20 value 169447.330101
## iter  30 value 169444.856908
## iter  40 value 169444.556911
## iter  50 value 169444.481985
## final  value 169444.476963
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173815.987160
## iter  10 value 169502.993450
## iter  20 value 169449.264719
## iter  30 value 169448.225464
## final  value 169448.190950
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 172985.863786
```

```
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 173843.842813
## iter  10 value 169491.105987
## iter  20 value 169444.709189
## iter  30 value 169444.509232
## iter  40 value 169444.429168
## final  value 169444.416289
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 171920.776888
## iter  10 value 169449.477712
## iter  20 value 169447.796027
## final  value 169447.777631
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 175360.209807
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 171236.225695
## iter  10 value 169459.663120
## iter  20 value 169444.614859
## iter  30 value 169444.384693
## final  value 169444.373305
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  296
## initial  value 174484.229341
## iter  10 value 169455.229376
## iter  20 value 169447.915404
## iter  30 value 169447.470014
## iter  30 value 169447.469242
## iter  30 value 169447.469073
## final  value 169447.469073
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 171596.375782
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175793.524736
## iter  10 value 169461.615731
## iter  20 value 169444.547457
## iter  30 value 169444.344012
## iter  30 value 169444.342351
## iter  30 value 169444.341212
## final  value 169444.341212
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 173449.683523
## iter  10 value 169606.738902
## iter  20 value 169450.882830
## iter  30 value 169447.536689
## iter  40 value 169447.270447
## iter  40 value 169447.269092
## final  value 169447.226576
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  414
## initial  value 173416.029518
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 172016.153564
## iter  10 value 169450.700579
## iter  20 value 169444.328649
## final  value 169444.309935
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175382.690980
## iter  10 value 169450.216603
## iter  20 value 169447.038644
## final  value 169447.020206
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 171576.794154
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176839.323951
## iter  10 value 169444.963383
## iter  20 value 169444.433673
## iter  30 value 169444.288398
## iter  30 value 169444.286827
## iter  30 value 169444.286293
## final  value 169444.286293
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 172780.702579
## iter  10 value 169449.217022
## iter  20 value 169446.851330
## final  value 169446.847338
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 172518.093276
## final  value 169443.878000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 174698.359578
## iter  10 value 169449.557797
## iter  20 value 169444.309643
## final  value 169444.267423
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 173884.833366
## iter  10 value 169448.842690
## iter  20 value 169446.710621
## final  value 169446.697130
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173539.002434
## final  value 169443.878000
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 175002.614532
## iter  10 value 169452.940849
## iter  20 value 169444.274298
## final  value 169444.247249
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 174105.569087
## iter  10 value 169465.571921
## iter  20 value 169446.851185
## iter  30 value 169446.615642
## iter  40 value 169446.564580
## iter  40 value 169446.563410
## iter  40 value 169446.563179
## final  value 169446.563179
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 175423.702508
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174723.808033
## iter  10 value 170365.746642
## iter  20 value 170254.963028
## iter  30 value 170253.757024
## final  value 170253.515741
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  60
## initial  value 173864.448012
## iter  10 value 170262.054397
## iter  20 value 170258.667142
## final  value 170258.606161
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 176193.066646
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 174178.142791
## iter  10 value 170374.816433
## iter  20 value 170255.685651
## iter  30 value 170253.593177
## iter  40 value 170253.316111
## final  value 170253.280049
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175111.952889
## iter  10 value 170289.698803
## iter  20 value 170257.929899
## final  value 170257.510987
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 174881.600351
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  178
## initial  value 175160.073789
## iter  10 value 170297.764784
## iter  20 value 170255.917111
## iter  30 value 170253.399170
## iter  40 value 170253.201393
## final  value 170253.175733
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173586.764587
## iter  10 value 170311.522920
## iter  20 value 170257.325371
## final  value 170256.898633
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 172682.546632
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 175620.168286
## iter  10 value 170278.721606
## iter  20 value 170254.814096
## iter  30 value 170253.317089
## iter  40 value 170253.144816
## final  value 170253.118869
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 175549.939829
## iter  10 value 170325.920492
## iter  20 value 170257.349511
## iter  30 value 170256.486468
```

```
## final  value 170256.483604
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174571.580521
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174073.928397
## iter  10 value 170254.807230
## iter  20 value 170253.424488
## iter  30 value 170253.137379
## final  value 170253.074307
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174295.780758
## iter  10 value 170347.049279
## iter  20 value 170257.307582
## iter  30 value 170256.181990
## final  value 170256.176035
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 176775.293871
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 172760.494180
## iter  10 value 170253.476102
```

```
## iter  20 value 170253.050084
## final  value 170253.041437
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 173052.467517
## iter  10 value 170259.323286
## iter  20 value 170255.967880
## final  value 170255.930907
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 174104.163990
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 174642.197640
## iter  10 value 170253.580354
## iter  20 value 170253.017166
## final  value 170253.012980
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175450.805289
## iter  10 value 170263.432546
## iter  20 value 170255.750234
## final  value 170255.725386
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176289.013363
```

```
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 175593.366098
## iter  10 value 170268.124467
## iter  20 value 170253.277778
## iter  30 value 170252.994570
## final  value 170252.988370
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176255.946325
## iter  10 value 170257.294966
## iter  20 value 170255.559656
## final  value 170255.551421
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 174013.512971
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175384.535293
## iter  10 value 170254.038870
## iter  20 value 170252.973217
## final  value 170252.967249
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 174923.692442
```

```
## iter  10 value 170262.288843
## iter  20 value 170255.687663
## iter  30 value 170255.404865
## final  value 170255.401480
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173021.401469
## final  value 170252.579600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 174480.990849
## iter  10 value 170253.071045
## final  value 170252.950787
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173752.477762
## iter  10 value 170257.108019
## iter  20 value 170255.285527
## final  value 170255.268700
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 175952.545905
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 173375.124241
## iter  10 value 170549.582324
```

```
## iter  20 value 170463.339906
## iter  30 value 170462.330039
## final  value 170462.047486
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174356.424913
## iter  10 value 170470.826936
## iter  20 value 170467.221164
## final  value 170467.214489
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 176729.727536
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 174643.490896
## iter  10 value 170481.098736
## iter  20 value 170462.750253
## iter  30 value 170462.259833
## iter  40 value 170461.925131
## final  value 170461.878725
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 173889.490371
## iter  10 value 170496.863825
## iter  20 value 170466.391205
## final  value 170466.121097
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  178
## initial  value 175085.740059
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173469.153537
## iter  10 value 170479.534191
## iter  20 value 170462.117333
## iter  30 value 170461.829938
## final  value 170461.784413
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 175308.323324
## iter  10 value 170515.279755
## iter  20 value 170465.982597
## final  value 170465.506558
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 173872.878632
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 175013.120283
## iter  10 value 170488.312628
## iter  20 value 170462.084804
## iter  30 value 170461.766494
## final  value 170461.725145
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  237
## initial  value 175041.758036
## iter  10 value 170530.696178
## iter  20 value 170467.058645
## iter  30 value 170465.093949
## iter  30 value 170465.092432
## iter  30 value 170465.092432
## final  value 170465.092432
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174682.753699
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174429.143245
## iter  10 value 170461.888890
## iter  20 value 170461.693071
## final  value 170461.679107
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 176874.566106
## iter  10 value 170466.349527
## iter  20 value 170464.784832
## iter  20 value 170464.783485
## iter  20 value 170464.783469
## final  value 170464.783469
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175342.271912
## final  value 170461.187900
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 173305.464609
## iter  10 value 170462.184585
## iter  20 value 170461.676082
## final  value 170461.647121
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175494.795642
## iter  10 value 170467.767371
## iter  20 value 170464.554795
## final  value 170464.537254
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 176291.929183
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175679.351112
## iter  10 value 170502.366303
## iter  20 value 170461.865344
## iter  30 value 170461.623186
## iter  30 value 170461.621839
## iter  30 value 170461.621119
## final  value 170461.621119
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 174240.054682
## iter  10 value 170469.259156
```

```
## iter  20 value 170464.432891
## final  value 170464.333616
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 174916.485239
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 175234.019912
## iter  10 value 170461.731955
## final  value 170461.596305
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176657.696698
## iter  10 value 170471.897516
## iter  20 value 170464.170824
## final  value 170464.161371
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 173796.682766
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175218.527415
## iter  10 value 170462.186176
## iter  20 value 170461.581489
```

```
## final  value 170461.575820
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 176871.102314
## iter  10 value 170512.222652
## iter  20 value 170464.087658
## final  value 170464.009661
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 177132.194439
## final  value 170461.187900
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173492.984417
## iter  10 value 170461.990393
## iter  20 value 170461.563356
## final  value 170461.559207
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 174602.259056
## iter  10 value 170516.738286
## iter  20 value 170464.408225
## iter  30 value 170464.120239
## iter  40 value 170463.968000
## final  value 170463.876448
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  60
## initial  value 175055.959323
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 176118.357071
## iter  10 value 170793.092978
## iter  20 value 170698.738031
## iter  30 value 170697.518264
## iter  40 value 170697.264705
## final  value 170697.240257
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 175330.260799
## iter  10 value 170706.830686
## iter  20 value 170702.411481
## final  value 170702.408507
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 176373.089828
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 173787.520219
## iter  10 value 170717.965458
## iter  20 value 170697.825156
## iter  30 value 170697.210264
## iter  40 value 170697.092325
## final  value 170697.071936
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 174183.848287
## iter  10 value 170738.028579
## iter  20 value 170701.660097
## final  value 170701.312694
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 172984.751503
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173737.449100
## iter  10 value 170712.989526
## iter  20 value 170697.576389
## iter  30 value 170697.093255
## iter  40 value 170696.986911
## final  value 170696.982420
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 176386.543280
## iter  10 value 170753.758564
## iter  20 value 170701.411428
## iter  30 value 170700.744070
## final  value 170700.714357
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 174934.959025
```

```
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 173384.541726
## iter  10 value 170697.140122
## iter  20 value 170696.940638
## final  value 170696.918349
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 175590.486384
## iter  10 value 170801.501059
## iter  20 value 170701.842421
## iter  30 value 170700.294828
## final  value 170700.288377
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174883.655317
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 173772.125259
## iter  10 value 170697.037548
## iter  20 value 170696.880534
## final  value 170696.874368
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 176023.534456
```

```
## iter  10 value 170909.338314
## iter  20 value 170707.339999
## iter  30 value 170700.033664
## final  value 170699.976687
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 173184.743947
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175213.703716
## iter  10 value 170697.068794
## final  value 170696.850462
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174105.724654
## iter  10 value 170876.765861
## iter  20 value 170701.251946
## iter  30 value 170699.762354
## final  value 170699.730500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 174335.060940
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 176097.685587
```

```
## iter  10 value 170725.449333
## iter  20 value 170697.533844
## iter  30 value 170696.819800
## final  value 170696.813409
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175897.728795
## iter  10 value 170706.766140
## iter  20 value 170699.538863
## final  value 170699.527438
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176288.414675
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176718.252609
## iter  10 value 170718.571688
## iter  20 value 170697.199442
## iter  30 value 170696.817049
## final  value 170696.790619
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176933.547547
## iter  10 value 170700.798282
## iter  20 value 170699.364417
## final  value 170699.353491
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  532
## initial  value 174408.766728
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 173558.787812
## iter  10 value 170705.473760
## iter  20 value 170696.814126
## final  value 170696.770026
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 174749.115891
## iter  10 value 170704.808671
## iter  20 value 170699.244040
## final  value 170699.206056
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 175581.117360
## final  value 170696.381100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 174896.895049
## iter  10 value 170697.446680
## iter  20 value 170696.760615
## final  value 170696.750775
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  591
## initial  value 177269.095364
## iter  10 value 170758.167557
## iter  20 value 170699.865921
## iter  30 value 170699.098310
## final  value 170699.071828
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 173288.471425
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 173514.358728
## iter  10 value 169474.461411
## iter  20 value 169369.849961
## iter  30 value 169368.087103
## iter  40 value 169367.818110
## iter  40 value 169367.817287
## iter  40 value 169367.816979
## final  value 169367.816979
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 173699.894674
## iter  10 value 169394.398233
## iter  20 value 169373.031219
## final  value 169372.978367
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 172658.166908
## final  value 169366.958600
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 173276.368437
## iter  10 value 169482.958129
## iter  20 value 169370.123202
## iter  30 value 169368.010623
## iter  40 value 169367.723738
## iter  50 value 169367.649797
## iter  50 value 169367.648219
## iter  50 value 169367.647353
## final  value 169367.647353
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 174662.638906
## iter  10 value 169408.366491
## iter  20 value 169372.030895
## final  value 169371.890585
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173076.161887
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 172177.165428
## iter  10 value 169487.323779
## iter  20 value 169371.241323
## iter  30 value 169368.161565
## iter  40 value 169367.671688
## iter  50 value 169367.559825
## final  value 169367.555237
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173938.507338
## iter  10 value 169423.054912
## iter  20 value 169371.950074
## final  value 169371.283081
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 172581.453788
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 172968.905399
## iter  10 value 169396.097713
## iter  20 value 169368.264981
## iter  30 value 169367.557596
## final  value 169367.502020
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 173905.445875
## iter  10 value 169437.526501
## iter  20 value 169371.491363
## final  value 169370.858516
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174113.921725
## final  value 169366.958600
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 172929.823926
## iter  10 value 169367.665485
## iter  20 value 169367.458899
## final  value 169367.449810
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174362.190138
## iter  10 value 169375.404040
## iter  20 value 169370.601265
## final  value 169370.549788
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174472.494248
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175859.675964
## iter  10 value 169397.542873
## iter  20 value 169370.375937
## iter  30 value 169367.591363
## iter  40 value 169367.440500
## final  value 169367.421405
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174290.100715
## iter  10 value 169376.777970
## iter  20 value 169370.446645
```

```
## final  value 169370.303968
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 172376.221628
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 174390.402860
## iter  10 value 169396.004858
## iter  20 value 169367.718792
## final  value 169367.395025
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 172585.240773
## iter  10 value 169371.723627
## iter  20 value 169370.102045
## iter  20 value 169370.100957
## iter  20 value 169370.100957
## final  value 169370.100957
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 172233.658805
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 171689.747828
## iter  10 value 169373.760369
```

```
## iter  20 value 169367.664272
## iter  30 value 169367.435331
## iter  40 value 169367.367943
## iter  40 value 169367.366503
## iter  40 value 169367.366052
## final  value 169367.366052
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 174110.286086
## iter  10 value 169379.852853
## iter  20 value 169369.965681
## final  value 169369.928084
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175486.422673
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 171430.808757
## iter  10 value 169367.743559
## iter  20 value 169367.359449
## final  value 169367.345109
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 173411.814577
## iter  10 value 169373.216584
## iter  20 value 169369.794327
## final  value 169369.776703
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173310.529325
## final  value 169366.958600
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 171459.013055
## iter  10 value 169368.103066
## iter  20 value 169367.348854
## final  value 169367.332200
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173788.594589
## iter  10 value 169371.443953
## iter  20 value 169369.647187
## final  value 169369.643698
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 176384.125937
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 175475.577419
## iter  10 value 170778.721038
## iter  20 value 170669.863288
## iter  30 value 170668.474850
## final  value 170668.392174
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174576.452238
## iter  10 value 170682.497144
## iter  20 value 170673.418467
## final  value 170673.396323
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 176039.206138
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 173499.378179
## iter  10 value 170758.847373
## iter  20 value 170670.391582
## iter  30 value 170668.337888
## iter  40 value 170668.076085
## final  value 170668.057890
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175842.132948
## iter  10 value 170706.979951
## iter  20 value 170672.740424
## final  value 170672.314390
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 174206.231393
## final  value 170667.369000
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 175866.220885
## iter  10 value 170691.453780
## iter  20 value 170668.203681
## iter  30 value 170667.975386
## final  value 170667.964551
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 175468.662757
## iter  10 value 170721.940896
## iter  20 value 170672.319432
## iter  30 value 170671.688833
## iter  30 value 170671.687325
## iter  30 value 170671.687267
## final  value 170671.687267
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 176452.235088
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 175765.249819
## iter  10 value 170700.723355
## iter  20 value 170668.250533
## iter  30 value 170667.944898
## final  value 170667.907221
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  237
## initial  value 174348.147617
## iter  10 value 170677.591641
## iter  20 value 170671.410572
## final  value 170671.274137
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 173287.848771
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 176892.205584
## iter  10 value 170703.056962
## iter  20 value 170669.239004
## iter  30 value 170667.915397
## final  value 170667.862738
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 177437.743232
## iter  10 value 170687.932425
## iter  20 value 170671.470326
## iter  30 value 170670.980734
## final  value 170670.968882
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174802.124472
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  355
## initial  value 177303.514999
## iter  10 value 170685.020567
## iter  20 value 170667.981987
## final  value 170667.829885
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174982.511463
## iter  10 value 170676.571585
## iter  20 value 170670.823667
## final  value 170670.719349
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175340.618055
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 178515.613041
## iter  10 value 170676.002350
## iter  20 value 170668.066102
## iter  30 value 170667.827440
## final  value 170667.801631
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175481.802690
## iter  10 value 170672.516743
## iter  20 value 170670.522969
## final  value 170670.514890
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176596.929991
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 174530.024693
## iter  10 value 170668.078859
## iter  20 value 170667.782195
## iter  20 value 170667.780607
## iter  20 value 170667.780044
## final  value 170667.780044
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 173442.965999
## iter  10 value 170673.291487
## iter  20 value 170670.399444
## final  value 170670.341934
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175104.674987
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 176716.078005
## iter  10 value 170679.229204
## iter  20 value 170668.114536
## iter  30 value 170667.786162
```

```
## final  value 170667.754471
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 176467.609555
## iter  10 value 170671.721807
## iter  20 value 170670.207911
## final  value 170670.190987
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173564.846420
## final  value 170667.369000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 177266.869965
## iter  10 value 170681.043833
## iter  20 value 170667.931649
## iter  30 value 170667.739040
## iter  30 value 170667.737407
## iter  30 value 170667.737163
## final  value 170667.737163
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 174747.224205
## iter  10 value 170673.773176
## iter  20 value 170670.069974
## final  value 170670.057475
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  60
## initial  value 175310.401316
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 175510.578927
## iter  10 value 171069.011696
## iter  20 value 170957.433345
## iter  30 value 170956.120789
## final  value 170955.893814
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174514.207908
## iter  10 value 170969.445472
## iter  20 value 170961.014247
## final  value 170960.991999
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 176125.463021
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 174078.262084
## iter  10 value 171064.891919
## iter  20 value 170958.133245
## iter  30 value 170955.991087
## iter  40 value 170955.690975
## final  value 170955.658670
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175112.573880
## iter  10 value 170992.509690
## iter  20 value 170960.282150
## iter  30 value 170959.895424
## final  value 170959.889530
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 176110.161338
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 174460.348046
## iter  10 value 170977.814667
## iter  20 value 170957.931643
## iter  30 value 170955.914065
## iter  40 value 170955.622295
## iter  50 value 170955.565029
## final  value 170955.553736
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 176740.922558
## iter  10 value 171011.520250
## iter  20 value 170959.752822
## final  value 170959.276523
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 174871.527282
```

```
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 174356.287166
## iter  10 value 170957.139222
## iter  20 value 170955.800349
## iter  30 value 170955.544331
## final  value 170955.494054
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 176341.845359
## iter  10 value 171027.986947
## iter  20 value 170959.375567
## iter  30 value 170958.864895
## iter  30 value 170958.864069
## iter  30 value 170958.863652
## final  value 170958.863652
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 176802.990522
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174635.246090
## iter  10 value 170955.889507
## iter  20 value 170955.496077
## final  value 170955.451284
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  296
## initial  value 175313.556740
## iter  10 value 170969.297025
## iter  20 value 170958.627258
## final  value 170958.557050
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174567.406946
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175261.910508
## iter  10 value 170955.769766
## iter  20 value 170955.428306
## final  value 170955.416896
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175651.527638
## iter  10 value 170961.178065
## iter  20 value 170958.362094
## final  value 170958.308782
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 176912.989370
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  414
## initial  value 176780.634922
## iter  10 value 170981.199573
## iter  20 value 170955.595796
## iter  30 value 170955.407330
## final  value 170955.388133
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 174305.641055
## iter  10 value 170960.337381
## iter  20 value 170958.113340
## final  value 170958.105489
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 175266.517512
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 173518.813289
## iter  10 value 170962.792437
## iter  20 value 170955.392400
## final  value 170955.367132
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 174783.354882
## iter  10 value 170958.576485
## final  value 170957.930235
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  532
## initial  value 175379.677126
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 176396.110859
## iter  10 value 170955.845700
## iter  20 value 170955.349558
## iter  20 value 170955.347931
## iter  20 value 170955.347342
## final  value 170955.347342
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175392.941365
## iter  10 value 170960.940152
## iter  20 value 170957.802919
## final  value 170957.780234
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 175558.636612
## final  value 170954.957500
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173237.589238
## iter  10 value 170956.152279
## iter  20 value 170955.338558
## final  value 170955.327003
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  591
## initial  value 176805.497412
## iter  10 value 170958.608859
## iter  20 value 170957.648259
## final  value 170957.645914
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174620.138771
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 175931.436761
## iter  10 value 170593.396597
## iter  20 value 170502.173303
## iter  30 value 170500.832871
## final  value 170500.744131
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174801.056018
## iter  10 value 170524.317347
## iter  20 value 170506.148066
## final  value 170505.834892
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175247.560678
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  119
## initial  value 175495.166425
## iter  10 value 170622.617748
## iter  20 value 170502.809148
## iter  30 value 170500.859836
## iter  40 value 170500.533713
## final  value 170500.498746
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 174646.317530
## iter  10 value 170543.834969
## iter  20 value 170504.810815
## final  value 170504.740903
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 174408.845650
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 173628.984269
## iter  10 value 170521.952907
## iter  20 value 170500.647637
## iter  30 value 170500.422479
## final  value 170500.403152
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 175904.712504
## iter  10 value 170557.021937
## iter  20 value 170504.688009
## final  value 170504.126640
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 175023.904479
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 174993.843095
## iter  10 value 170526.102315
## iter  20 value 170500.621619
## iter  30 value 170500.362362
## final  value 170500.342745
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 175105.908048
## iter  10 value 170578.082193
## iter  20 value 170504.191563
## final  value 170503.719026
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 176941.696617
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 174778.012284
## iter  10 value 170543.055386
## iter  20 value 170501.291025
## iter  30 value 170500.357603
## final  value 170500.303433
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 175047.560378
## iter  10 value 170620.048168
## iter  20 value 170522.881427
## iter  30 value 170503.800642
## iter  40 value 170503.479446
## iter  40 value 170503.479399
## iter  40 value 170503.479399
## final  value 170503.479399
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174880.444073
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 176812.809446
## iter  10 value 170514.577001
## iter  20 value 170501.471817
## iter  30 value 170500.771949
## iter  40 value 170500.357872
## iter  50 value 170500.276753
## final  value 170500.271877
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 173382.023470
## iter  10 value 170507.343338
## iter  20 value 170503.208034
## final  value 170503.157760
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  414
## initial  value 172239.883233
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175012.201947
## iter  10 value 170500.468956
## iter  20 value 170500.256027
## final  value 170500.238709
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 173642.896335
## iter  10 value 170518.137198
## iter  20 value 170503.027609
## final  value 170502.954643
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 173966.774037
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 173786.369517
## iter  10 value 170507.736956
## iter  20 value 170500.263287
## final  value 170500.218592
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  473
## initial  value 176282.120296
## iter  10 value 170505.386417
## iter  20 value 170502.786885
## final  value 170502.780478
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175486.022402
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 172067.324133
## iter  10 value 170500.697047
## iter  20 value 170500.215666
## final  value 170500.196714
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175004.237933
## iter  10 value 170535.160283
## iter  20 value 170502.705952
## final  value 170502.629549
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 173249.308079
## final  value 170499.808000
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07
```

```
## # weights:  591
## initial  value 175402.162267
## iter  10 value 170509.847584
## iter  20 value 170500.213442
## final  value 170500.181779
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 176667.103987
## iter  10 value 170560.013534
## iter  20 value 170502.938101
## iter  30 value 170502.507692
## iter  30 value 170502.506119
## final  value 170502.496661
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174865.192230
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 174404.908843
## iter  10 value 170947.396331
## iter  20 value 170855.806054
## iter  30 value 170854.562556
## iter  40 value 170854.308257
## final  value 170854.297986
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 176913.480196
## iter  10 value 170864.159810
## iter  20 value 170859.797527
## iter  30 value 170859.468056
```

```
## final  value 170859.465250
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 174403.984729
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175201.522918
## iter  10 value 170970.501688
## iter  20 value 170856.680571
## iter  30 value 170854.501335
## iter  40 value 170854.183355
## final  value 170854.137044
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  119
## initial  value 175050.852974
## iter  10 value 170891.973799
## iter  20 value 170859.301233
## iter  30 value 170858.626239
## final  value 170858.369810
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 174957.207581
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 174758.462939
```

```
## iter  10 value 170878.527765
## iter  20 value 170854.316536
## iter  30 value 170854.067624
## final  value 170854.036389
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  178
## initial  value 176568.843605
## iter  10 value 170908.460957
## iter  20 value 170859.196998
## iter  30 value 170857.786473
## final  value 170857.755436
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 174744.484611
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 176098.581828
## iter  10 value 170886.778712
## iter  20 value 170854.464101
## iter  30 value 170853.997608
## final  value 170853.972513
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  237
## initial  value 173483.021547
## iter  10 value 170860.534682
## iter  20 value 170857.379928
## final  value 170857.341651
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 175091.938687
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 175805.414535
## iter  10 value 170875.808190
## iter  20 value 170854.370125
## iter  30 value 170853.982368
## final  value 170853.928153
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  296
## initial  value 175559.544837
## iter  10 value 170862.219581
## iter  20 value 170857.143400
## final  value 170857.033734
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174937.003363
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 174929.859362
## iter  10 value 170854.570435
## iter  20 value 170853.920681
## final  value 170853.897502
## converged
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  355
## initial  value 175381.291414
## iter  10 value 170911.236562
## iter  20 value 170856.966031
## iter  30 value 170856.801801
## final  value 170856.789369
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 175375.862862
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 172044.244120
## iter  10 value 170864.516920
## iter  20 value 170854.870547
## iter  30 value 170854.061552
## iter  40 value 170853.889620
## final  value 170853.874833
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  414
## initial  value 176891.000644
## iter  10 value 170861.555004
## iter  20 value 170856.612481
## final  value 170856.583634
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 177011.417883
```

```
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 176705.994789
## iter  10 value 170879.709583
## iter  20 value 170854.063843
## final  value 170853.847606
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  473
## initial  value 175684.417367
## iter  10 value 170859.007527
## iter  20 value 170856.415666
## final  value 170856.409786
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 177459.368867
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 175227.927629
## iter  10 value 170854.266360
## iter  20 value 170853.828339
## final  value 170853.824627
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  532
## initial  value 177323.551264
## iter  10 value 170903.796517
```

```
## iter  20 value 170856.264708
## final  value 170856.258612
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 174285.273691
## final  value 170853.437100
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 176228.274274
## iter  10 value 170862.728173
## iter  20 value 170853.815633
## final  value 170853.807743
## converged

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  591
## initial  value 176500.942655
## iter  10 value 170864.925395
## iter  20 value 170856.264932
## iter  30 value 170856.169435
## iter  40 value 170856.127460
## iter  40 value 170856.126058
## iter  40 value 170856.125963
## final  value 170856.125963
## converged

## Warning in nominalTrainWorkflow(x = x, y = y, wts = weights, info =
trainInfo, :
## There were missing values in resampled performance measures.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## # weights:  60
## initial  value 193533.341261
## final  value 189106.033500
## converged
```

```
##      RMSE Rsquared       MAE
## 39.24164       NA 39.20038
```

SVM Performace

```
library(mlbench)
svm_rst = evaluation('svmRadial')

## Warning in preProcess.default(method = c("center", "scale"), x =
## structure(list(: These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.
```

```
## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

## Warning in .local(x, ...): Variable(s) `' constant. Cannot scale data.

##      RMSE  Rsquared       MAE
## 1.1463921 0.6880977 0.9427456
```

MARS Performance

```
marsGrid = expand.grid(degree = 1:2, nprune = 2:15)
mars_rst = evaluation('earth', marsGrid)

## Warning in preProcess.default(thresh = 0.95, k = 5, freqCut = 19,
uniqueCut =
## 10, : These variables have zero variances: BiologicalMaterial07

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## 10, : These variables have zero variances: BiologicalMaterial07

##      RMSE  Rsquared       MAE
## 0.9520777 0.7362918 0.8203221

df_performance= rbind(data.frame(Name = 'KNN', RMSE = knn_rst[1]),
data.frame(Name= 'Neural Network', RMSE = net_rst[1]) , data.frame(Name =
'SVM', RMSE = svm_rst[1]), data.frame(Name = 'MARS', RMSE = mars_rst[1]))
ggplot(data =df_performance, aes(x = Name, y = RMSE, fill=Name)) +
  geom_bar(stat="identity", position=position_dodge()) +
  geom_text(aes(label=RMSE), vjust=1, color="white",
            position = position_dodge(0.9), size=3.5)
```

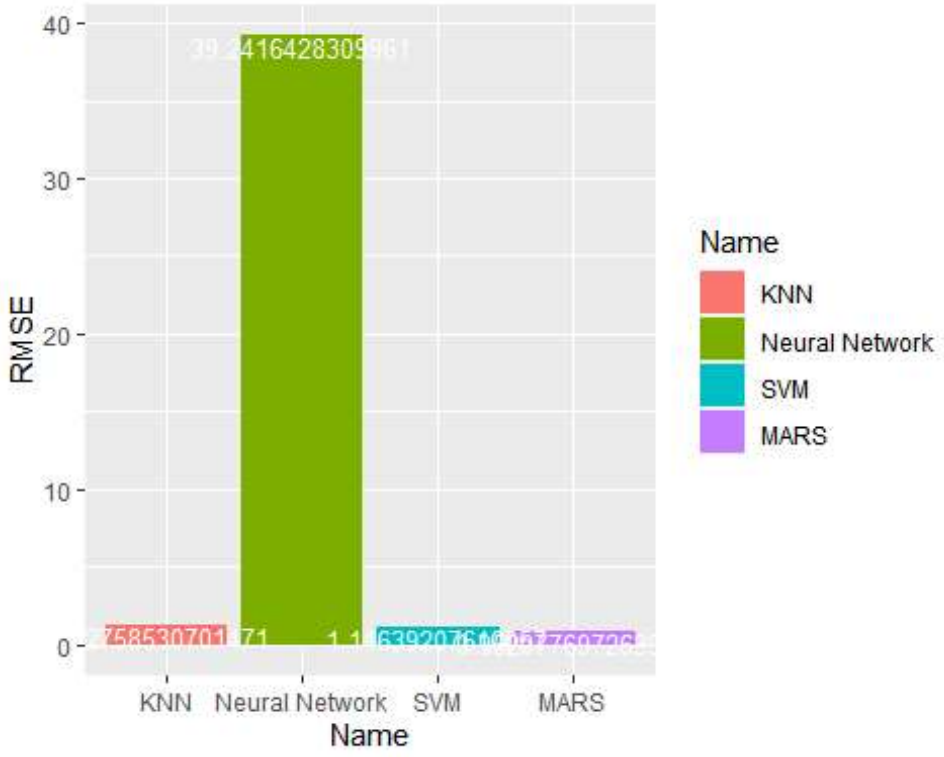

A

Which nonlinear regression model gives the optimal resampling and test set performance?

ANS :

As we can see from above graph, The MARS model outperform among all the other models.The model performance metric RMSE gives minimum result for MARS model.

B

Which predictors are most important in the optimal nonlinear regression model? Do either the biological or process variables dominate the list? How do the top ten important predictors compare to the top ten predictors from the optimal linear model?

```
marsGrid = expand.grid(degree = 1:2, nprune = 2:38)
MARSModel = train(x = train[,-1], y = train$Yield, method = 'earth', tuneGrid
= marsGrid, preProcess = c('center', 'scale'), trControl =
trainControl(method='cv'))

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varImp(MARSModel)

## earth variable importance
##
##                          Overall
## ManufacturingProcess32  100.00
## ManufacturingProcess09   32.62
## ManufacturingProcess13    0.00
```

ANS:

The graph on above shows aus Neural Network model's top best features.

The Neural Network models (Which performs the best among the other models) gives us most important features as ranked above graph. The Neural Network models says that the most important feaute is ManufacturingProcess32 (100), and next ManufacturingProcess09 (32.62) ,ManufacturingProcess13 (0.00).

```
summary(MARSModel)

## Call: earth(x=data.frame[123,57], y=c(38.66,38.67,3...), keepxy=TRUE,
degree=1,
##             nprune=4)
##
##                                      coefficients
## (Intercept)                             38.781735
```

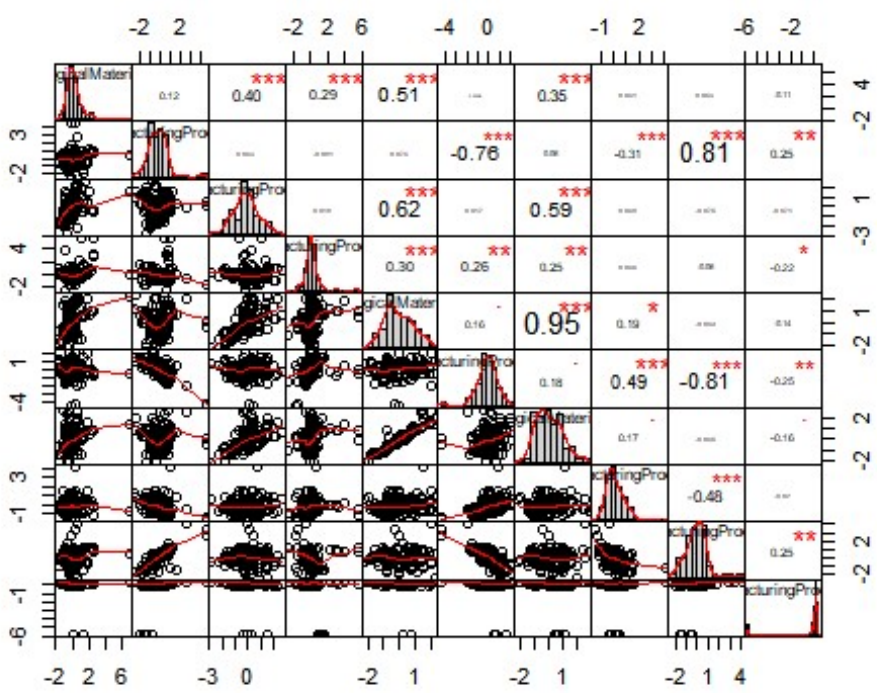
```
## h(-1.02888-ManufacturingProcess09)     -1.354290
## h(-1.27561-ManufacturingProcess13)      3.705496
## h(ManufacturingProcess32- -1.10694)     1.147357
##
## Selected 4 of 21 terms, and 3 of 57 predictors (nprune=4)
## Termination condition: RSq changed by less than 0.001 at 21 terms
## Importance: ManufacturingProcess32, ManufacturingProcess09, ...
## Number of terms at each degree of interaction: 1 3 (additive model)
## GCV 1.711083    RSS 187.1897    GRSq 0.5122766    RSq 0.5590697
```

C

Explore the relationships between the top predictors and the response for the predictors that are unique to the optimal nonlinear regression model. Do these plots reveal intuition about the biological or process predictors and their relationship with yield?

ANS:

I'm going to plot correlation plot to see relationships



The graph above shows top 10 important features correlation with target varianle "Yield". As we can in graph above, there are variables that have non-linear realtionship with target variable "Yield".In addition to that, there are also variables that have linear correlationship with "Yield" target variable.