KNN

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```
### Install packages if not loaded
# install.packages("FNN")
# install.packages("vcd")
# install.packages("mltest")
library(FNN)
library(vcd)
```

```
## Warning: package 'vcd' was built under R version 3.6.2
```

```
## Loading required package: grid
```

```
library(mltest)
```

```
# Make sure the code and data are in the same path. Otherwise, set the directory
# setwd("/users/seth/downloads/459/milestone2/")

### Read the data that were separeated by Python in Q2.1
X.train.raw = read.csv("./dataset/x_train.csv", header = T, na.strings = "NA", stringsAsFactors = F)
X.valid.raw = read.csv("./dataset/x_test.csv", header = T, na.strings = "NA", stringsAsFactors = F)
Y.train = read.csv("./dataset/y_train.csv", header = F, stringsAsFactors = F )
Y.valid = read.csv("./dataset/y_test.csv", header = F, stringsAsFactors = F)
```

```
### Some Data Processing
# Factorize the Y labels
Y.train$V1 = as.factor(Y.train$V1)
Y.valid$V1 = as.factor(Y.valid$V1)

# Scale the X variables
scale.1 <- function(x1,x2){
  for(col in 1:ncol(x1)){
    a <- mean(x2[,col])
    b <- sd(x2[,col])
    if(b!= 0){
      x1[,col] <- (x1[,col]-a)/b
    }else{
      x1[,col] = 0
    }
  }
  x1
}

X.train = scale.1(X.train.raw, X.train.raw)
X.valid = scale.1(X.valid.raw, X.train.raw)
```

```
### Milestone 3: Hyperparameter tuning in KNN

K.max = c(1,5,8,10,15,20,50,100) # Maximum number of neighbours

### Container to store CV misclassification rates
```

```r
mis.CV = rep(0, times = 8)


for(i in 1:8){
  ### Progress update
  print(paste0(i, " of ", K.max))

  ### Fit leave-one-out CV
  this.knn = knn.cv(X.train, Y.train$V1, k=K.max[i])

  ### Get and store CV misclassification rate
  this.mis.CV = mean(this.knn != Y.train$V1)
  mis.CV[i] = this.mis.CV
  print(ml_test(this.knn, Y.train$V1))
}
```

```
## [1] "1 of 1"   "1 of 5"   "1 of 8"   "1 of 10"  "1 of 15"  "1 of 20"
## [7] "1 of 50"  "1 of 100"
```

```
## Warning in TP * TN: NAs produced by integer overflow
```

```
## $accuracy
## [1] 0.847976
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5881222       0.8509815       0.9994956       0.7772726
##
## $DOR
##        deceased    hospitalized nonhospitalized       recovered
##    2.553588e+01    3.284890e+01    5.958688e+06    1.897389e+01
##
## $error.rate
## [1] 0.152024
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.2081045       0.8260826       0.9996088       0.6559116
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##       0.1988197       0.8305462       0.9994559       0.6499784
##
## $F2
##        deceased    hospitalized nonhospitalized       recovered
##       0.1903279       0.8350583       0.9993030       0.6441516
##
## $FDR
##        deceased    hospitalized nonhospitalized       recovered
##    0.7852082743    0.1768666384    0.0002892593    0.3400724200
##
## $FNR
##        deceased    hospitalized nonhospitalized       recovered
##    0.8149414062    0.1619062718    0.0007988618    0.3596752728
##
```

```
## $FOR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0105987433    0.1240965319    0.0005796749    0.0927851687
##
## $FPR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0088142861    0.1361306993    0.0002098647    0.0857796245
##
## $geometric.mean
##        deceased    hospitalized nonhospitalized       recovered
##       0.4282843       0.8508839       0.9994956       0.7651130
##
## $Jaccard
##        deceased    hospitalized nonhospitalized       recovered
##       0.1103830       0.7102001       0.9989123       0.4814578
##
## $L
##        deceased    hospitalized nonhospitalized       recovered
##       20.995302        6.156537     4761.167129        7.464765
##
## $lambda
##        deceased    hospitalized nonhospitalized       recovered
##    0.8221884101    0.1874198697    0.0007990295    0.3934229453
##
## $MCC
##        deceased    hospitalized nonhospitalized       recovered
##       0.1897046              NA              NA              NA
##
## $MK
##        deceased    hospitalized nonhospitalized       recovered
##       0.2041930       0.6990368       0.9991311       0.5671424
##
## $NPV
##        deceased    hospitalized nonhospitalized       recovered
##       0.9894013       0.8759035       0.9994203       0.9072148
##
## $OP
##        deceased    hospitalized nonhospitalized       recovered
##       0.1626362       0.8328314       0.8476814       0.6717858
##
## $precision
##        deceased    hospitalized nonhospitalized       recovered
##       0.2147917       0.8231334       0.9997107       0.6599276
##
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##       0.1850586       0.8380937       0.9992011       0.6403247
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9911857       0.8638693       0.9997901       0.9142204
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
```

```
##       0.1762443       0.7019630       0.9989913       0.5545451
##
## [1] "2 of 1"   "2 of 5"   "2 of 8"   "2 of 10"  "2 of 15"  "2 of 20"
## [7] "2 of 50"  "2 of 100"

## Warning in TP * TN: NAs produced by integer overflow

## $accuracy
## [1] 0.8718845
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5561493       0.8765532       0.9991367       0.7954590
##
## $DOR
##        deceased    hospitalized nonhospitalized       recovered
##    1.724550e+02    5.098634e+01    1.459396e+06    2.817943e+01
##
## $error.rate
## [1] 0.1281155
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.3357019       0.8417773       0.9990655       0.7128779
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##       0.1930776       0.8591313       0.9989994       0.6894717
##
## $F2
##        deceased    hospitalized nonhospitalized       recovered
##       0.1355069       0.8772159       0.9989333       0.6675537
##
## $FDR
##        deceased    hospitalized nonhospitalized       recovered
##    0.3385714286    0.1694077389    0.0008903568    0.2706146147
##
## $FNR
##        deceased    hospitalized nonhospitalized       recovered
##     0.886962891     0.110298687     0.001110798     0.346300240
##
## $FOR
##        deceased    hospitalized nonhospitalized       recovered
##      0.01120121      0.08772558      0.00076832      0.08729770
##
## $FPR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0007384466    0.1365949362    0.0006158024    0.0627818448
##
## $geometric.mean
##        deceased    hospitalized nonhospitalized       recovered
##       0.3360858       0.8764546       0.9991367       0.7827255
##
## $Jaccard
##        deceased    hospitalized nonhospitalized       recovered
```

```
##       0.1068544       0.7530501       0.9980008       0.5261021
##
## $L
##        deceased    hospitalized nonhospitalized       recovered
##      153.074186        6.513428     1622.093613       10.412242
##
## $lambda
##        deceased    hospitalized nonhospitalized       recovered
##     0.887618349     0.127748483     0.001111483     0.369498006
##
## $MCC
##        deceased    hospitalized nonhospitalized       recovered
##       0.2702215              NA              NA              NA
##
## $MK
##        deceased    hospitalized nonhospitalized       recovered
##       0.6502274       0.7428667       0.9983413       0.6420877
##
## $NPV
##        deceased    hospitalized nonhospitalized       recovered
##       0.9887988       0.9122744       0.9992317       0.9127023
##
## $OP
##        deceased    hospitalized nonhospitalized       recovered
##      0.07513409      0.85688472      0.87163682      0.69367395
##
## $precision
##        deceased    hospitalized nonhospitalized       recovered
##       0.6614286       0.8305923       0.9991096       0.7293854
##
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##       0.1130371       0.8897013       0.9988892       0.6536998
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9992616       0.8634051       0.9993842       0.9372182
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
##       0.1122987       0.7531064       0.9982734       0.5909179
##
## [1] "3 of 1"   "3 of 5"   "3 of 8"   "3 of 10"  "3 of 15"  "3 of 20"
## [7] "3 of 50"  "3 of 100"

## Warning in TP * TN: NAs produced by integer overflow

## $accuracy
## [1] 0.8729894
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5543095       0.8813343       0.9990681       0.7716102
##
## $DOR
```

```
##        deceased    hospitalized nonhospitalized       recovered
##    4.562741e+02    6.332731e+01    1.254879e+06    3.109433e+01
##
## $error.rate
## [1] 0.1270106
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.3582905       0.8316520       0.9989925       0.7295209
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##       0.1927398       0.8641295       0.9989195       0.6686022
##
## $F2
##        deceased    hospitalized nonhospitalized       recovered
##       0.1318279       0.8992468       0.9988465       0.6170734
##
## $FDR
##        deceased    hospitalized nonhospitalized       recovered
##    0.1616541353    0.1886766196    0.0009588676    0.2233004579
##
## $FNR
##        deceased    hospitalized nonhospitalized       recovered
##     0.891113281     0.075711840     0.001202097     0.413082246
##
## $FOR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0112383421    0.0635848001    0.0008295879    0.1006077500
##
## $FPR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0002677318    0.1616194849    0.0006616813    0.0436973342
##
## $geometric.mean
##        deceased    hospitalized nonhospitalized       recovered
##       0.3299357       0.8802870       0.9990681       0.7491802
##
## $Jaccard
##        deceased    hospitalized nonhospitalized       recovered
##       0.1066475       0.7607642       0.9978413       0.5021806
##
## $L
##        deceased    hospitalized nonhospitalized       recovered
##      406.700757        5.718915     1509.484856       13.431432
##
## $lambda
##        deceased    hospitalized nonhospitalized       recovered
##     0.891351924     0.090307251     0.001202893     0.431957644
##
## $MCC
##        deceased    hospitalized nonhospitalized       recovered
##       0.2997325              NA              NA              NA
##
```

```
## $MK
##        deceased    hospitalized nonhospitalized       recovered
##       0.8271075       0.7477386       0.9982115       0.6760918
##
## $NPV
##        deceased    hospitalized nonhospitalized       recovered
##       0.9887617       0.9364152       0.9991704       0.8993922
##
## $OP
##        deceased    hospitalized nonhospitalized       recovered
##       0.0694261       0.8242522       0.8727190       0.6336296
##
## $precision
##        deceased    hospitalized nonhospitalized       recovered
##       0.8383459       0.8113234       0.9990411       0.7766995
##
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##       0.1088867       0.9242882       0.9987979       0.5869178
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9997323       0.8383805       0.9993383       0.9563027
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
##       0.1086190       0.7626687       0.9981362       0.5432204
##
## [1] "4 of 1"   "4 of 5"   "4 of 8"   "4 of 10"  "4 of 15"  "4 of 20"
## [7] "4 of 50"  "4 of 100"

## Warning in TP * TN: NAs produced by integer overflow

## $accuracy
## [1] 0.8739314
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5498335       0.8819279       0.9990333       0.7756271
##
## $DOR
##        deceased    hospitalized nonhospitalized       recovered
##    5.944292e+02    6.310170e+01    1.191766e+06    3.146554e+01
##
## $error.rate
## [1] 0.1260686
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.3424313       0.8335205       0.9989833       0.7311638
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##       0.1791895       0.8647799       0.9988852       0.6738789
##
```

```
## $F2
##       deceased    hospitalized nonhospitalized       recovered
##      0.1213434       0.8984752       0.9987872       0.6249180
##
## $FDR
##       deceased    hospitalized nonhospitalized       recovered
##    0.1279317697    0.1860930969    0.0009513372    0.2249104408
##
## $FNR
##       deceased    hospitalized nonhospitalized       recovered
##     0.900146484     0.077563574     0.001278179     0.403952622
##
## $FOR
##       deceased    hospitalized nonhospitalized       recovered
##     0.011337569     0.064818544     0.000880397     0.098712153
##
## $FPR
##       deceased    hospitalized nonhospitalized       recovered
##    0.0001865817    0.1585806039    0.0006552049    0.0447932500
##
## $geometric.mean
##       deceased    hospitalized nonhospitalized       recovered
##      0.3159666       0.8809971       0.9990333       0.7545518
##
## $Jaccard
##       deceased    hospitalized nonhospitalized       recovered
##      0.09841193      0.76177284      0.99777291      0.50815785
##
## $L
##       deceased    hospitalized nonhospitalized       recovered
##      535.17324         5.81683      1524.28919        13.30663
##
## $lambda
##       deceased    hospitalized nonhospitalized       recovered
##     0.900314467     0.092181823     0.001279017     0.422895485
##
## $MCC
##       deceased    hospitalized nonhospitalized       recovered
##      0.2928931              NA              NA              NA
##
## $MK
##       deceased    hospitalized nonhospitalized       recovered
##      0.8607307       0.7490884       0.9981683       0.6763774
##
## $NPV
##       deceased    hospitalized nonhospitalized       recovered
##      0.9886624       0.9351815       0.9991196       0.9012878
##
## $OP
##       deceased    hospitalized nonhospitalized       recovered
##      0.05553826      0.82799965      0.87361963      0.64240303
##
## $precision
##       deceased    hospitalized nonhospitalized       recovered
```

```
##       0.8720682       0.8139069       0.9990487       0.7750896
##
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##      0.09985352      0.92243643      0.99872182      0.59604738
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9998134       0.8414194       0.9993448       0.9552068
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
##      0.09966693      0.76385582      0.99806662      0.55125413
##
## [1] "5 of 1"   "5 of 5"   "5 of 8"   "5 of 10"  "5 of 15"  "5 of 20"
## [7] "5 of 50"  "5 of 100"
```

```
## Warning in TP * TN: NAs produced by integer overflow
```

```
## $accuracy
## [1] 0.874211
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5458036       0.8806437       0.9988731       0.7869383
##
## $DOR
##        deceased    hospitalized nonhospitalized       recovered
##       532.96658        57.71616    986906.33465        30.44897
##
## $error.rate
## [1] 0.125789
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.3216975       0.8381340       0.9989540       0.7264382
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##       0.1658946       0.8634881       0.9987328       0.6852015
##
## $F2
##        deceased    hospitalized nonhospitalized       recovered
##       0.1117651       0.8904241       0.9985116       0.6483950
##
## $FDR
##        deceased    hospitalized nonhospitalized       recovered
##    0.1395881007    0.1779574053    0.0008984316    0.2431980177
##
## $FNR
##        deceased    hospitalized nonhospitalized       recovered
##     0.908203125     0.090665229     0.001635765     0.374021826
##
## $FOR
##        deceased    hospitalized nonhospitalized       recovered
```

```
##     0.011433103     0.074104213     0.001125537     0.092723404
##
## $FPR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0001896106    0.1480474637    0.0006180502    0.0521016456
##
## $geometric.mean
##        deceased    hospitalized nonhospitalized       recovered
##       0.3029513       0.8801762       0.9988730       0.7703010
##
## $Jaccard
##        deceased    hospitalized nonhospitalized       recovered
##      0.09044984      0.75977047      0.99746874      0.52114564
##
## $L
##        deceased    hospitalized nonhospitalized       recovered
##      484.133709        6.142184     1615.344872       12.014557
##
## $lambda
##        deceased    hospitalized nonhospitalized       recovered
##     0.908375363     0.106420517     0.001636776     0.394580098
##
## $MCC
##        deceased    hospitalized nonhospitalized       recovered
##       0.2788774              NA              NA              NA
##
## $MK
##        deceased    hospitalized nonhospitalized       recovered
##       0.8489788       0.7479384       0.9979760       0.6640786
##
## $NPV
##        deceased    hospitalized nonhospitalized       recovered
##       0.9885669       0.9258958       0.9988745       0.9072766
##
## $OP
##        deceased    hospitalized nonhospitalized       recovered
##      0.04239767      0.84163132      0.87370161      0.66967137
##
## $precision
##        deceased    hospitalized nonhospitalized       recovered
##       0.8604119       0.8220426       0.9991016       0.7568020
##
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##      0.09179688      0.90933477      0.99836424      0.62597817
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9998104       0.8519525       0.9993819       0.9478984
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
##      0.09160726      0.76128731      0.99774619      0.57387653
##
```

```
## [1] "6 of 1"   "6 of 5"   "6 of 8"   "6 of 10"  "6 of 15"  "6 of 20"
## [7] "6 of 50"  "6 of 100"
```

```
## Warning in TP * TN: NAs produced by integer overflow
```

```
## $accuracy
## [1] 0.8716266
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5431069       0.8784562       0.9985861       0.7808458
##
## $DOR
##        deceased    hospitalized nonhospitalized       recovered
##       446.18808        55.89245    714778.60922        29.02847
##
## $error.rate
## [1] 0.1283734
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.3060166       0.8343122       0.9988241       0.7210107
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##       0.1567065       0.8611128       0.9984431       0.6765727
##
## $F2
##        deceased    hospitalized nonhospitalized       recovered
##       0.1053195       0.8896923       0.9980625       0.6372943
##
## $FDR
##        deceased    hospitalized nonhospitalized       recovered
##    0.1611374408    0.1826468410    0.0009217643    0.2459724244
##
## $FNR
##        deceased    hospitalized nonhospitalized       recovered
##     0.913574219     0.090176929     0.002191164     0.386451956
##
## $FOR
##        deceased    hospitalized nonhospitalized       recovered
##     0.011532902     0.074130066     0.001514084     0.095516281
##
## $FPR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0002119773    0.1529105955    0.0006366846    0.0518564749
##
## $geometric.mean
##        deceased    hospitalized nonhospitalized       recovered
##       0.2939515       0.8778961       0.9985858       0.7627133
##
## $Jaccard
##        deceased    hospitalized nonhospitalized       recovered
##      0.08501441      0.75610013      0.99689111      0.51122767
##
```

```
## $L
##        deceased    hospitalized nonhospitalized       recovered
##      407.712352        5.950033     1567.194842       11.831657
##
## $lambda
##        deceased    hospitalized nonhospitalized       recovered
##      0.91376792      0.10645503      0.00219256      0.40758804
##
## $MCC
##        deceased    hospitalized nonhospitalized       recovered
##       0.2670716              NA              NA              NA
##
## $MK
##        deceased    hospitalized nonhospitalized       recovered
##       0.8273297       0.7432231       0.9975642       0.6585113
##
## $NPV
##        deceased    hospitalized nonhospitalized       recovered
##       0.9884671       0.9258699       0.9984859       0.9044837
##
## $OP
##        deceased    hospitalized nonhospitalized       recovered
##       0.0307588       0.8359199       0.8708483       0.6573747
##
## $precision
##        deceased    hospitalized nonhospitalized       recovered
##       0.8388626       0.8173532       0.9990782       0.7540276
##
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##      0.08642578      0.90982307      0.99780884      0.61354804
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9997880       0.8470894       0.9993633       0.9481435
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
##       0.0862138       0.7569125       0.9971722       0.5616916
##
## [1] "7 of 1"   "7 of 5"   "7 of 8"   "7 of 10"  "7 of 15"  "7 of 20"
## [7] "7 of 50"  "7 of 100"

## Warning in TP * TN: NAs produced by integer overflow

## $accuracy
## [1] 0.8635666
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5384389       0.8720505       0.9944931       0.7644059
##
## $DOR
##        deceased    hospitalized nonhospitalized       recovered
##       308.91362        52.20800    144925.40044        26.44491
```

```
##
## $error.rate
## [1] 0.1364334
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.2769986       0.8215632       0.9971529       0.7101935
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##       0.1405069       0.8542594       0.9943242       0.6541271
##
## $F2
##        deceased    hospitalized nonhospitalized       recovered
##      0.09412606      0.88966585      0.99151152      0.60626532
##
## $FDR
##        deceased    hospitalized nonhospitalized       recovered
##     0.213930348     0.198878370     0.000952381     0.246765859
##
## $FNR
##        deceased    hospitalized nonhospitalized       recovered
##      0.92285156      0.08505295      0.01035477      0.42193239
##
## $FOR
##        deceased    hospitalized nonhospitalized       recovered
##     0.011754828     0.071629994     0.007186192     0.103481366
##
## $FPR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0002705457    0.1708459539    0.0006590346    0.0492557979
##
## $geometric.mean
##        deceased    hospitalized nonhospitalized       recovered
##       0.2777185       0.8709949       0.9944813       0.7413464
##
## $Jaccard
##        deceased    hospitalized nonhospitalized       recovered
##      0.07556193      0.74559577      0.98871246      0.48602439
##
## $L
##        deceased    hospitalized nonhospitalized       recovered
##      285.158566        5.355392     1501.658939       11.736032
##
## $lambda
##        deceased    hospitalized nonhospitalized       recovered
##       0.9231013       0.1025780       0.0103616       0.4437917
##
## $MCC
##        deceased    hospitalized nonhospitalized       recovered
##        0.243983              NA              NA              NA
##
## $MK
##        deceased    hospitalized nonhospitalized       recovered
```

```
##       0.7743148       0.7294916       0.9918614       0.6497528
##
## $NPV
##        deceased    hospitalized nonhospitalized       recovered
##       0.9882452       0.9283700       0.9928138       0.8965186
##
## $OP
##        deceased    hospitalized nonhospitalized       recovered
##     0.006848326     0.814376261     0.858691932     0.619797861
##
## $precision
##        deceased    hospitalized nonhospitalized       recovered
##       0.7860697       0.8011216       0.9990476       0.7532341
##
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##      0.07714844      0.91494705      0.98964523      0.57806761
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9997295       0.8291540       0.9993410       0.9507442
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
##      0.07687789      0.74410109      0.98898619      0.52881181
##
## [1] "8 of 1"   "8 of 5"   "8 of 8"   "8 of 10"  "8 of 15"  "8 of 20"
## [7] "8 of 50"  "8 of 100"
```

```
## Warning in TP * TN: NAs produced by integer overflow
```

```
## $accuracy
## [1] 0.8528218
##
## $balanced.accuracy
##        deceased    hospitalized nonhospitalized       recovered
##       0.5220119       0.8631689       0.9876931       0.7478892
##
## $DOR
##        deceased    hospitalized nonhospitalized       recovered
##       279.14347        47.29274     52145.30108        23.60892
##
## $error.rate
## [1] 0.1471782
##
## $F0.5
##        deceased    hospitalized nonhospitalized       recovered
##       0.1799920       0.8064511       0.9942409       0.6954466
##
## $F1
##        deceased    hospitalized nonhospitalized       recovered
##      0.08362208      0.84502908      0.98738687      0.62963191
##
## $F2
##        deceased    hospitalized nonhospitalized       recovered
```

```
##       0.0544623       0.8874834       0.9806267       0.5751972
##
## $FDR
##        deceased    hospitalized nonhospitalized       recovered
##      0.22317597      0.21736851      0.00113662      0.25246040
##
## $FNR
##        deceased    hospitalized nonhospitalized       recovered
##      0.95581055      0.08176168      0.02382891      0.45614852
##
## $FOR
##        deceased    hospitalized nonhospitalized       recovered
##      0.01231589      0.07074581      0.01657362      0.11144239
##
## $FPR
##        deceased    hospitalized nonhospitalized       recovered
##    0.0001655951    0.1919004423    0.0007849927    0.0480730379
##
## $geometric.mean
##        deceased    hospitalized nonhospitalized       recovered
##       0.2101955       0.8614105       0.9876258       0.7195185
##
## $Jaccard
##        deceased    hospitalized nonhospitalized       recovered
##      0.04363549      0.73164533      0.97508797      0.45946189
##
## $L
##        deceased    hospitalized nonhospitalized       recovered
##      266.852459        4.784972     1243.541681       11.313025
##
## $lambda
##        deceased    hospitalized nonhospitalized       recovered
##      0.95596885      0.10117774      0.02384763      0.47918437
##
## $MCC
##        deceased    hospitalized nonhospitalized       recovered
##       0.1834573              NA              NA              NA
##
## $MK
##        deceased    hospitalized nonhospitalized       recovered
##       0.7645081       0.7118857       0.9822898       0.6360972
##
## $NPV
##        deceased    hospitalized nonhospitalized       recovered
##       0.9876841       0.9292542       0.9834264       0.8885576
##
## $OP
##        deceased    hospitalized nonhospitalized       recovered
##      -0.0625260       0.7890227       0.8411563       0.5800037
##
## $precision
##        deceased    hospitalized nonhospitalized       recovered
##       0.7768240       0.7826315       0.9988634       0.7475396
##
```

```
## $recall
##        deceased    hospitalized nonhospitalized       recovered
##      0.04418945      0.91823832      0.97617109      0.54385148
##
## $specificity
##        deceased    hospitalized nonhospitalized       recovered
##       0.9998344       0.8080996       0.9992150       0.9519270
##
## $Youden
##        deceased    hospitalized nonhospitalized       recovered
##      0.04402386      0.72633787      0.97538610      0.49577844
```

```r
### Get standard errors
SE.mis.CV = sapply(mis.CV, function(r){
  sqrt(r*(1-r)/nrow(X.train))
})
```

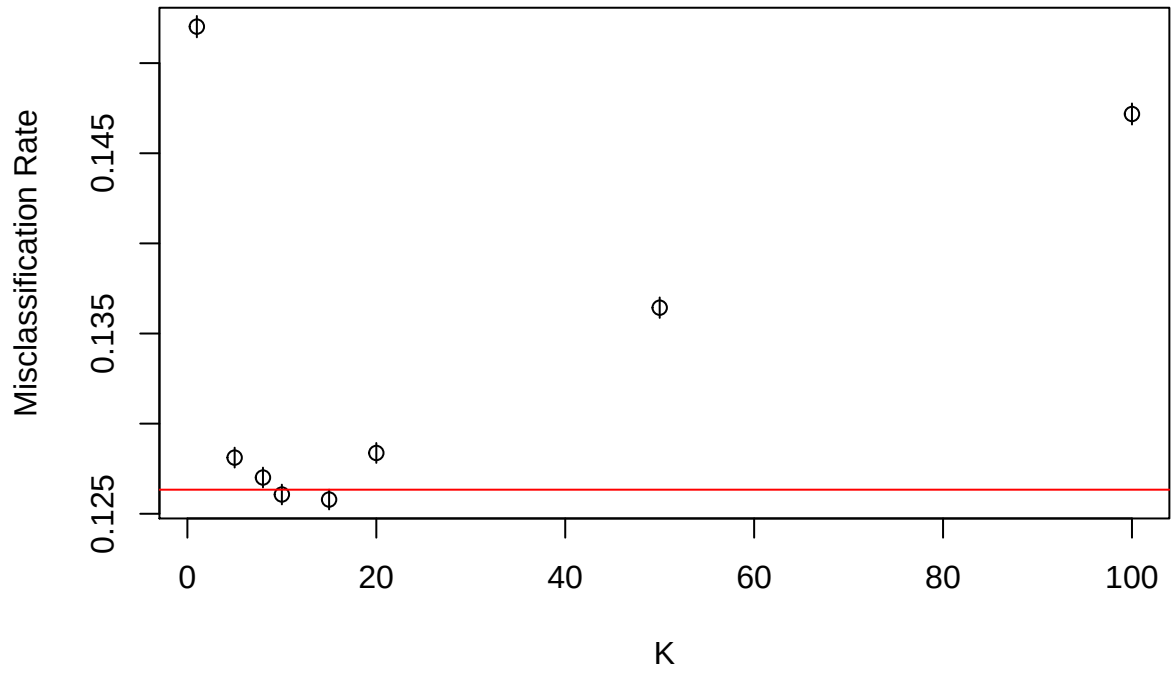
```r
plot(K.max, mis.CV, xlab = "K", ylab = "Misclassification Rate")

for(i in 1:8){
  lower = mis.CV[i] - SE.mis.CV[i]
  upper = mis.CV[i] + SE.mis.CV[i]

  lines(x = c(K.max[i], K.max[i]), y = c(lower, upper))
}

### Get CV min value for K
k.min = which.min(mis.CV)

### Add a horizontal line at min + 1SE
thresh = mis.CV[k.min] + SE.mis.CV[k.min]
abline(h = thresh, col = "red")
```



```r
### Get CV 1SE value for K
k.1se = max(which(mis.CV <= thresh))
```