Initial medical data preparation

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2022-08-03

Prepare for initial analysis

```
set.seed(123)
library(lubridate)

##
## Attaching package: 'lubridate'

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

library(ggplot2)

## Warning: package 'ggplot2' was built under R version 4.2.1

library(randomForest)

## Warning: package 'randomForest' was built under R version 4.2.1

## randomForest 4.7-1.1

## Type rfNews() to see new features/changes/bug fixes.

##
## Attaching package: 'randomForest'

## The following object is masked from 'package:ggplot2':
##
##     margin

library(dplyr)

##
## Attaching package: 'dplyr'

## The following object is masked from 'package:randomForest':
##
##     combine

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

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

```
library(rpart)
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.2.1

## Loading required package: lattice

## Warning: package 'lattice' was built under R version 4.2.1
```

```
library(e1071)
```

```
## Warning: package 'e1071' was built under R version 4.2.1
```

```
library(corrplot)
```

```
## corrplot 0.92 loaded
```

Functions to clean datasets

Read data sets from csv file

```
clean_dataset <- function() {
  datasetloc = "C:/Users/mavul/OneDrive/Desktop/Health care data.csv"
  if (file.exists(datasetloc)) {
    data <- read.csv(file=datasetloc, header = T)
  }
  return(data)
}
```

Partition #The data were partitioned into a test and training set using a 70/30 split

```
set.seed(100)
train <- sample(nrow(clean_dataset()), 0.7*nrow(clean_dataset()), replace = F
ALSE)
TrainSet <- clean_dataset()[train,]
TestSet <- clean_dataset()[-train,]
summary(TrainSet)
```

```
##       id                gender              dob               zipcode
##  Length:1400        Length:1400        Length:1400        Min.   :10001
##  Class :character   Class :character   Class :character   1st Qu.:43221
##  Mode  :character   Mode  :character   Mode  :character   Median :60612
##                                                           Mean   :62877
##                                                           3rd Qu.:90008
##                                                           Max.   :94110
##  employment_status   education          marital_status        children
##  Length:1400        Length:1400        Length:1400        Min.   :0.000
##  Class :character   Class :character   Class :character   1st Qu.:1.000
##  Mode  :character   Mode  :character   Mode  :character   Median :2.000
```

```
##                                                            Mean   :2.227  
##                                                            3rd Qu.:3.000  
##                                                            Max.   :7.000  
##    ancestry          avg_commute    daily_internet_use available_vehicles
##  Length:1400        Min.   :-2.47   Min.   :1.010      Min.   :0.000     
##  Class :character   1st Qu.:23.61   1st Qu.:4.070      1st Qu.:1.000     
##  Mode  :character   Median :30.39   Median :5.020      Median :2.000     
##                     Mean   :30.43   Mean   :5.009      Mean   :1.746     
##                     3rd Qu.:37.18   3rd Qu.:5.945      3rd Qu.:3.000     
##                     Max.   :63.73   Max.   :8.640      Max.   :4.000     
##  military_service     disease         
##  Length:1400        Length:1400       
##  Class :character   Class :character  
##  Mode  :character   Mode  :character  
##                                       
##                                       
##                                       
```

```
summary(TestSet)
```

```
##       id               gender              dob               zipcode     
##  Length:600         Length:600         Length:600         Min.   :10001  
##  Class :character   Class :character   Class :character   1st Qu.:43221  
##  Mode  :character   Mode  :character   Mode  :character   Median :60612  
##                                                           Mean   :64579  
##                                                           3rd Qu.:90008  
##                                                           Max.   :94110  
##  employment_status   education         marital_status       children    
##  Length:600         Length:600         Length:600         Min.   :0.000  
##  Class :character   Class :character   Class :character   1st Qu.:1.000  
##  Mode  :character   Mode  :character   Mode  :character   Median :2.000  
##                                                           Mean   :2.358  
##                                                           3rd Qu.:3.000  
##                                                           Max.   :7.000  
##    ancestry          avg_commute    daily_internet_use available_vehicles
##  Length:600         Min.   : 4.63   Min.   :1.250      Min.   :0.000     
##  Class :character   1st Qu.:23.30   1st Qu.:3.938      1st Qu.:1.000     
##  Mode  :character   Median :29.91   Median :4.930      Median :2.000     
##                     Mean   :30.26   Mean   :4.958      Mean   :1.747     
##                     3rd Qu.:37.09   3rd Qu.:5.990      3rd Qu.:3.000     
##                     Max.   :61.66   Max.   :8.820      Max.   :4.000     
##  military_service     disease         
##  Length:600         Length:600        
##  Class :character   Class :character  
##  Mode  :character   Mode  :character  
##                                       
##                                       
##                                       
```

Analysing the disease

The data set will predict the marital status with selected attributes that contributes to the analysis

```
disease_TrainSet <- select(TrainSet, gender, employment_status, education, ma
rital_status, ancestry, disease)
disease_TestSet <- select(TestSet, gender, employment_status, education, mari
tal_status, ancestry, disease)
disease_TrainSet$disease <- as.factor(disease_TrainSet$disease)
```

Logistic Regression Model

The model was fit using a binomial logistic regression with the glm function in R, with family = binomial on the training data.

```
fit <- glm(disease~.,data=disease_TrainSet,family=binomial())
summary(fit)

##
## Call:
## glm(formula = disease ~ ., family = binomial(), data = disease_TrainSet)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.3393   0.4403   0.5440   0.6441   1.0067
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                    2.19000    0.37667   5.814  6.1e-09 ***
## gendermale                     0.03196    0.14765   0.216 0.828649
## employment_statusretired      -0.59919    0.16538  -3.623 0.000291 ***
## employment_statusstudent      -0.40097    1.13363  -0.354 0.723564
## employment_statusunemployed   -0.17617    0.28038  -0.628 0.529790
## educationhighschool           -0.31052    0.20498  -1.515 0.129800
## educationhighscool            13.38707  723.39477   0.019 0.985235
## educationmasters              -0.12839    0.21414  -0.600 0.548810
## educationphd/md                0.08960    0.26839   0.334 0.738493
## educationphD/MD               14.00046  481.18170   0.029 0.976788
## marital_statussingle           0.31020    0.18310   1.694 0.090238 .
## ancestryBelgium               -0.21598    0.46794  -0.462 0.644394
## ancestryCzech Republic         0.16894    0.53153   0.318 0.750605
## ancestryDenmark               -0.83234    0.43726  -1.904 0.056972 .
## ancestryEngland                0.32945    0.50949   0.647 0.517882
## ancestryFinland               -0.40610    0.47259  -0.859 0.390165
## ancestryFrance                -0.33601    0.47969  -0.700 0.483638
## ancestryGermany               -0.21203    0.46892  -0.452 0.651142
## ancestryHungary               -0.40526    0.48217  -0.840 0.400631
## ancestryIreland               -0.05155    0.46598  -0.111 0.911906
## ancestryItaly                 -0.35404    0.47117  -0.751 0.452413
```

```
## ancestryNetherlands           0.07750    0.48447   0.160 0.872910
## ancestryPoland               -0.35193    0.45597  -0.772 0.440208
## ancestryPortugal              0.06311    0.48426   0.130 0.896308
## ancestryRussia               -0.86443    0.44835  -1.928 0.053852 .
## ancestryScotland             -0.66546    0.46906  -1.419 0.155982
## ancestrySpain                 0.01601    0.51393   0.031 0.975150
## ancestrySweden                0.16839    0.49568   0.340 0.734076
## ancestrySwitzerland          -0.52548    0.43980  -1.195 0.232159
## ancestryUkraine              -0.13572    0.51885  -0.262 0.793645
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1257.3  on 1399  degrees of freedom
## Residual deviance: 1214.1  on 1370  degrees of freedom
## AIC: 1274.1
##
## Number of Fisher Scoring iterations: 14
```

```
confint(fit)
```

```
## Waiting for profiling to be done...
```

```
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## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
##                                     2.5 %       97.5 %
## (Intercept)                    1.49310795  2.981983016
## gendermale                    -0.25786241  0.321451399
## employment_statusretired      -0.92785940 -0.278718811
## employment_statusstudent      -2.31644858  2.593249869
## employment_statusunemployed   -0.71917959  0.382573039
## educationhighschool           -0.70805338  0.096693127
## educationhighscool           -69.45973894           NA
## educationmasters              -0.54008833  0.301313496
## educationphd/md               -0.41765298  0.639333730
## educationphD/MD              -85.57307046           NA
## marital_statussingle          -0.04143041  0.677631890
## ancestryBelgium               -1.15214453  0.701580323
## ancestryCzech Republic        -0.86444750  1.250416462
## ancestryDenmark               -1.72198660  0.006793701
## ancestryEngland               -0.66860072  1.356370401
## ancestryFinland               -1.35123141  0.520177091
## ancestryFrance                -1.29176670  0.608895559
## ancestryGermany               -1.14995333  0.707492641
## ancestryHungary               -1.36593697  0.544167167
## ancestryIreland               -0.98383541  0.862453401
## ancestryItaly                 -1.29647330  0.569533833
## ancestryNetherlands           -0.88319757  1.038468463
## ancestryPoland                -1.26989871  0.534913406
## ancestryPortugal              -0.89729025  1.023564349
## ancestryRussia                -1.77291681 -0.000330003
```

```
## ancestryScotland            -1.60667582  0.249496457
## ancestrySpain               -0.99118858  1.050582435
## ancestrySweden              -0.80919936  1.158627641
## ancestrySwitzerland         -1.41776928  0.322136248
## ancestryUkraine             -1.15273134  0.907692356
```

```
exp(coef(fit))
```

```
##                 (Intercept)                  gendermale
##                8.935227e+00                1.032472e+00
##    employment_statusretired    employment_statusstudent
##                5.492537e-01                6.696732e-01
## employment_statusunemployed         educationhighschool
##                8.384750e-01                7.330646e-01
##          educationhighscool             educationmasters
##                6.515256e+05                8.795114e-01
##             educationphd/md             educationphD/MD
##                1.093741e+00                1.203159e+06
##       marital_statussingle             ancestryBelgium
##                1.363698e+00                8.057475e-01
##      ancestryCzech Republic             ancestryDenmark
##                1.184052e+00                4.350307e-01
##             ancestryEngland             ancestryFinland
##                1.390197e+00                6.662430e-01
##              ancestryFrance             ancestryGermany
##                7.146188e-01                8.089375e-01
##             ancestryHungary             ancestryIreland
##                6.668019e-01                9.497524e-01
##               ancestryItaly         ancestryNetherlands
##                7.018501e-01                1.080580e+00
##              ancestryPoland            ancestryPortugal
##                7.033265e-01                1.065146e+00
##              ancestryRussia            ancestryScotland
##                4.212932e-01                5.140393e-01
##               ancestrySpain              ancestrySweden
##                1.016138e+00                1.183392e+00
##         ancestrySwitzerland             ancestryUkraine
##                5.912699e-01                8.730862e-01
```

```
exp(confint(fit))
```

```
## Waiting for profiling to be done...

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## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
##                                    2.5 %     97.5 %
## (Intercept)                 4.450907e+00 19.7268966
## gendermale                  7.727015e-01  1.3791280
## employment_statusretired    3.953992e-01  0.7567527
## employment_statusstudent    9.862322e-02 13.3731621
## employment_statusunemployed 4.871518e-01  1.4660520
## educationhighschool         4.926022e-01  1.1015223
## educationhighscool          6.823680e-31         NA
```

```
## educationmasters            5.826968e-01  1.3516330
## educationphd/md             6.585907e-01  1.8952177
## educationphD/MD             6.856267e-38         NA
## marital_statussingle        9.594161e-01  1.9692089
## ancestryBelgium             3.159585e-01  2.0169376
## ancestryCzech Republic      4.212842e-01  3.4917969
## ancestryDenmark             1.787108e-01  1.0068168
## ancestryEngland             5.124251e-01  3.8820773
## ancestryFinland             2.589212e-01  1.6823255
## ancestryFrance              2.747849e-01  1.8383999
## ancestryGermany             3.166515e-01  2.0288977
## ancestryHungary             2.551415e-01  1.7231727
## ancestryIreland             3.738744e-01  2.3689656
## ancestryItaly               2.734946e-01  1.7674429
## ancestryNetherlands         4.134587e-01  2.8248873
## ancestryPoland              2.808601e-01  1.7073004
## ancestryPortugal            4.076729e-01  2.7830970
## ancestryRussia              1.698369e-01  0.9996701
## ancestryScotland            2.005532e-01  1.2833790
## ancestrySpain               3.711353e-01  2.8593160
## ancestrySweden              4.452144e-01  3.1855585
## ancestrySwitzerland         2.422538e-01  1.3800728
## ancestryUkraine             3.157731e-01  2.4785962

#predict(fit, type="response")
#residuals(fit, type="deviance")
```

Performance

Probabilities for the response variable based on the test data were assigned using the predict function.

```
#probs <- predict(fit, test, type = "response")
#pred <- predict(fit, newdata = TestSet)
#pred
```

Confusion Matrix

```
#confusionMatrix(pred, TestSet$disease)
```

Random forest model

Apply randomforest model

```
# Fine tuning parameters of Random Forest model
model2 <- randomForest(disease ~ ., data = disease_TrainSet,  importance = TR
UE)
model2

##
## Call:
##  randomForest(formula = disease ~ ., data = disease_TrainSet,      importa
```

```
nce = TRUE)
##                Type of random forest: classification
##                      Number of trees: 500
## No. of variables tried at each split: 2
##
##         OOB estimate of  error rate: 83.29%
## Confusion matrix:
##                     Alzheimer's disease breast cancer diabetes endometrios
is
## Alzheimer's disease                  85            42        2
1
## breast cancer                        31            30        0
1
## diabetes                             33             7        1
1
## endometriosis                        10            15        2
0
## gastritis                            21            13        0
0
## heart disease                        17             8        1
0
## HIV/AIDS                              9             8        0
0
## hypertension                         52            34        0
1
## kidney disease                       34            20        0
1
## multiple sclerosis                   29            14        0
0
## prostate cancer                      60             0        0
0
## schizophrenia                        17             3        0
0
## skin cancer                          60            23        1
0
##                     gastritis heart disease HIV/AIDS hypertension
## Alzheimer's disease         1             2        1           31
## breast cancer               0             1        0           24
## diabetes                    0             1        1           10
## endometriosis               0             0        1            6
## gastritis                   0             0        1           12
## heart disease               0             0        0            8
## HIV/AIDS                    1             0        0            6
## hypertension                1             1        1           29
## kidney disease              0             1        1           13
## multiple sclerosis          1             1        0            6
## prostate cancer             0             0        1            7
## schizophrenia               2             0        0            7
## skin cancer                 0             0        1           17
##                     kidney disease multiple sclerosis prostate cancer
```

```
## Alzheimer's disease                5                  2               37
## breast cancer                      6                  1                0
## diabetes                           6                  0               18
## endometriosis                      6                  0                0
## gastritis                          2                  0               14
## heart disease                      4                  0               22
## HIV/AIDS                           4                  0               21
## hypertension                      12                  1               43
## kidney disease                    17                  1               39
## multiple sclerosis                 4                  0               14
## prostate cancer                    4                  0               55
## schizophrenia                      0                  1                8
## skin cancer                        7                  0               41
##                       schizophrenia skin cancer class.error
## Alzheimer's disease               0          23   0.6336207
## breast cancer                     0          11   0.7142857
## diabetes                          0           5   0.9879518
## endometriosis                     0           5   1.0000000
## gastritis                         2           5   1.0000000
## heart disease                     0           4   1.0000000
## HIV/AIDS                          1           2   1.0000000
## hypertension                      1          21   0.8527919
## kidney disease                    0          10   0.8759124
## multiple sclerosis                1           7   1.0000000
## prostate cancer                   0           4   0.5801527
## schizophrenia                     0           2   1.0000000
## skin cancer                       0          17   0.8982036
```

```
# Predicting on train set
predTrain <- predict(model2, disease_TrainSet, type = "class")

# Checking classification accuracy
table(predTrain, disease_TrainSet$disease)
```

```
##
## predTrain              Alzheimer's disease breast cancer diabetes endometri
osis
##   Alzheimer's disease                  147            13       31
12
##   breast cancer                         23            65        7
13
##   diabetes                               1             0        9
0
##   endometriosis                          0             0        0
2
##   gastritis                              0             0        0
0
##   heart disease                          2             0        0
0
##   HIV/AIDS                               0             0        1
```

```
1
##   hypertension                       17            13        9
7
##   kidney disease                      4             3        5
5
##   multiple sclerosis                  0             0        0
0
##   prostate cancer                    25             0       17
0
##   schizophrenia                       0             0        0
0
##   skin cancer                        13            11        4
5
##
## predTrain             gastritis heart disease HIV/AIDS hypertension
##   Alzheimer's disease        21            13        6           47
##   breast cancer              12             9        9           20
##   diabetes                    0             0        0            0
##   endometriosis               0             0        0            0
##   gastritis                   5             0        0            0
##   heart disease               0            11        0            1
##   HIV/AIDS                    1             1       13            1
##   hypertension               13             6        4           86
##   kidney disease              1             2        1            3
##   multiple sclerosis          0             0        0            0
##   prostate cancer            12            18       16           28
##   schizophrenia               1             0        0            0
##   skin cancer                 4             4        3           11
##
## predTrain             kidney disease multiple sclerosis prostate cancer
##   Alzheimer's disease             31                 28              44
##   breast cancer                   18                 15               0
##   diabetes                         0                  0               0
##   endometriosis                    0                  0               0
##   gastritis                        0                  0               0
##   heart disease                    0                  1               0
##   HIV/AIDS                         1                  0               0
##   hypertension                     9                  5               3
##   kidney disease                  35                  2               0
##   multiple sclerosis               0                  6               0
##   prostate cancer                 34                 14              83
##   schizophrenia                    0                  0               0
##   skin cancer                      9                  6               1
##
## predTrain             schizophrenia skin cancer
##   Alzheimer's disease            17          43
##   breast cancer                   3          19
##   diabetes                        0           0
##   endometriosis                   0           0
##   gastritis                       0           0
```

```
##   heart disease                  0          0
##   HIV/AIDS                       0          0
##   hypertension                   7         16
##   kidney disease                 0          6
##   multiple sclerosis             1          0
##   prostate cancer                7         36
##   schizophrenia                  3          0
##   skin cancer                    2         47
```

```r
model2 <- na.omit(model2)

# Predicting on Validation set
predValid <- predict(model2, disease_TestSet, type = "class")

# Checking classification accuracy
mean(predValid == disease_TestSet$disease)
```

```
## [1] 0.1666667
```

```r
table(predValid,disease_TestSet$disease)
```

```
##
## predValid            Alzheimer's disease breast cancer diabetes endometri
osis
##   Alzheimer's disease                  43            14       15
7
##   breast cancer                        14             8        5
8
##   diabetes                              1             0        0
0
##   endometriosis                         0             0        0
0
##   gastritis                             0             0        0
0
##   heart disease                         0             0        0
0
##   HIV/AIDS                              1             1        0
1
##   hypertension                          8             7       10
5
##   kidney disease                        7             4        1
0
##   multiple sclerosis                    0             0        0
0
##   prostate cancer                      26             0        4
0
##   schizophrenia                         0             0        0
0
##   skin cancer                           7             6        1
0
##
```

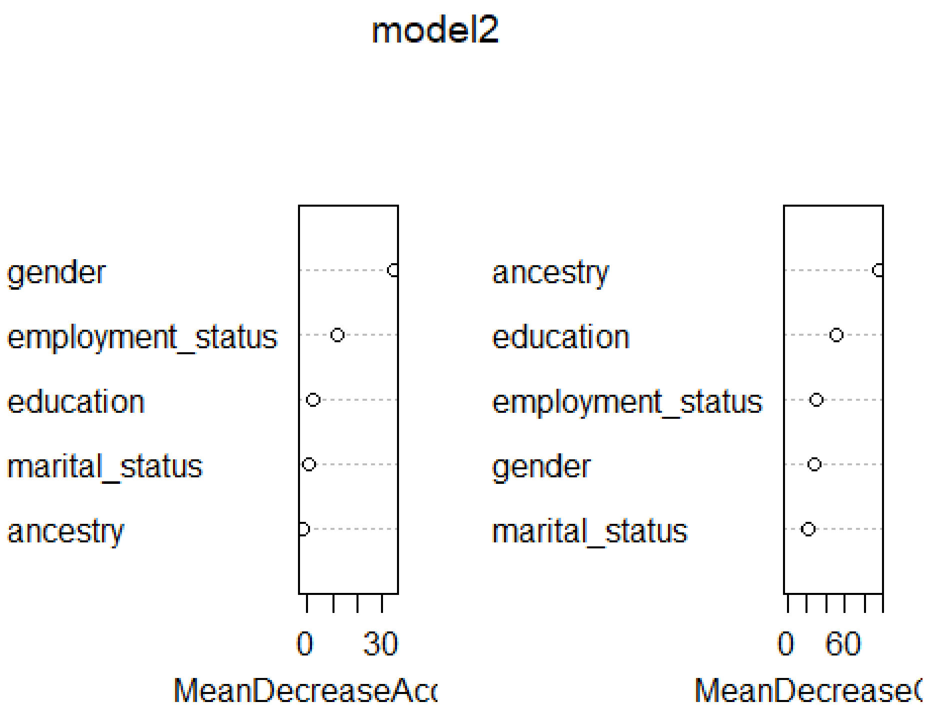
```
## predValid             gastritis heart disease HIV/AIDS hypertension
##   Alzheimer's disease        10            10        2           31
##   breast cancer               3             0        3           17
##   diabetes                    0             1        0            0
##   endometriosis               0             0        0            0
##   gastritis                   0             0        0            0
##   heart disease               0             1        0            2
##   HIV/AIDS                    0             0        0            2
##   hypertension                3             1        5           11
##   kidney disease              3             2        1            6
##   multiple sclerosis          0             0        0            1
##   prostate cancer            10             4       11           18
##   schizophrenia               0             0        0            0
##   skin cancer                 1             4        6           13
##
## predValid             kidney disease multiple sclerosis prostate cancer
##   Alzheimer's disease             19                 14              15
##   breast cancer                    5                  3               0
##   diabetes                         0                  0               0
##   endometriosis                    0                  0               0
##   gastritis                        0                  0               0
##   heart disease                    1                  0               1
##   HIV/AIDS                         0                  0               0
##   hypertension                     8                  4               3
##   kidney disease                   4                  1               1
##   multiple sclerosis               0                  0               0
##   prostate cancer                 10                 13              29
##   schizophrenia                    0                  0               0
##   skin cancer                      1                  1               0
##
## predValid             schizophrenia skin cancer
##   Alzheimer's disease             6          29
##   breast cancer                   2          11
##   diabetes                        0           0
##   endometriosis                   0           1
##   gastritis                       0           0
##   heart disease                   0           1
##   HIV/AIDS                        1           0
##   hypertension                    1           3
##   kidney disease                  1           4
##   multiple sclerosis              0           0
##   prostate cancer                 4          13
##   schizophrenia                   0           0
##   skin cancer                     0           4
```

```
# To check important variables
importance(model2)
```

```
##                     Alzheimer's disease breast cancer  diabetes endometriosi
s
```

```
## gender                     -0.3069681    28.0718616 -1.380107    7.8601294
4
## employment_status           8.8371133    -0.2679983  1.728054   -3.3498795
1
## education                  -8.1680115     1.3234619  2.799283   -1.9265688
3
## marital_status             -0.8301061    -7.1404512  5.529093   -0.0408413
8
## ancestry                   -4.4430299    -5.1554326  4.351547   -4.6347698
5
##                   gastritis heart disease   HIV/AIDS hypertension
## gender            -3.092683     4.3303144  2.8995935    1.5726714
## employment_status -2.737173    -0.4860694  5.9254210    4.7360929
## education         -7.936120     2.2773281  4.0985963    0.4401083
## marital_status     0.690441     4.2159322 -0.3571497    1.8884930
## ancestry          -2.603470    -0.4569619  5.6758207    1.9357525
##                   kidney disease multiple sclerosis prostate cancer
## gender                 10.428706          1.6532290       37.528819
## employment_status       9.456225         -5.7025661        1.454414
## education               8.865393         -1.5262814        2.838719
## marital_status          9.664055         -0.5272205       -6.919649
## ancestry                7.473705         -0.2640322       -7.662150
##                   schizophrenia skin cancer MeanDecreaseAccuracy
## gender               -7.7424957    5.196389           35.3158589
## employment_status     1.8606180    5.647893           12.0488859
## education             2.9206449    4.813521            1.8113220
## marital_status       -4.6329632    2.994119            0.9381829
## ancestry             -0.9734494    3.714359           -2.2621348
##                   MeanDecreaseGini
## gender                    28.16827
## employment_status         30.39493
## education                 50.73786
## marital_status            21.08354
## ancestry                  96.29308

varImpPlot(model2)
```



Naive Bayes Model

```
NBclassfier = naiveBayes(disease~., data=disease_TrainSet)
print(NBclassfier)

##
## Naive Bayes Classifier for Discrete Predictors
##
## Call:
## naiveBayes.default(x = X, y = Y, laplace = laplace)
##
## A-priori probabilities:
## Y
## Alzheimer's disease       breast cancer            diabetes        endometr
iosis
##          0.16571429          0.07500000          0.05928571           0.032
14286
##           gastritis       heart disease            HIV/AIDS          hyperte
nsion
##          0.05000000          0.04571429          0.03714286           0.140
71429
##      kidney disease  multiple sclerosis     prostate cancer        schizoph
renia
##          0.09785714          0.05500000          0.09357143           0.028
57143
##         skin cancer
##          0.11928571
```

```
##
## Conditional probabilities:
##                      gender
## Y                        female      male
##   Alzheimer's disease 0.4870690 0.5129310
##   breast cancer       1.0000000 0.0000000
##   diabetes            0.4337349 0.5662651
##   endometriosis       1.0000000 0.0000000
##   gastritis           0.4714286 0.5285714
##   heart disease       0.3906250 0.6093750
##   HIV/AIDS            0.4423077 0.5576923
##   hypertension        0.5025381 0.4974619
##   kidney disease      0.5109489 0.4890511
##   multiple sclerosis  0.4545455 0.5454545
##   prostate cancer     0.0000000 1.0000000
##   schizophrenia       0.4250000 0.5750000
##   skin cancer         0.4670659 0.5329341
##
##                      employment_status
## Y                        employed     retired     student  unemployed
##   Alzheimer's disease 0.288793103 0.586206897 0.004310345 0.120689655
##   breast cancer       0.390476190 0.485714286 0.009523810 0.114285714
##   diabetes            0.313253012 0.530120482 0.012048193 0.144578313
##   endometriosis       0.288888889 0.533333333 0.000000000 0.177777778
##   gastritis           0.428571429 0.371428571 0.042857143 0.157142857
##   heart disease       0.453125000 0.390625000 0.000000000 0.156250000
##   HIV/AIDS            0.673076923 0.115384615 0.019230769 0.192307692
##   hypertension        0.345177665 0.517766497 0.010152284 0.126903553
##   kidney disease      0.489051095 0.364963504 0.007299270 0.138686131
##   multiple sclerosis  0.363636364 0.493506494 0.025974026 0.116883117
##   prostate cancer     0.381679389 0.488549618 0.000000000 0.129770992
##   schizophrenia       0.350000000 0.500000000 0.075000000 0.075000000
##   skin cancer         0.407185629 0.526946108 0.000000000 0.065868263
##
##                      education
## Y                       bachelors  highschool   highscool     masters
##   Alzheimer's disease 0.508620690 0.245689655 0.000000000 0.159482759
##   breast cancer       0.580952381 0.190476190 0.000000000 0.152380952
##   diabetes            0.481927711 0.313253012 0.000000000 0.132530120
##   endometriosis       0.533333333 0.222222222 0.000000000 0.111111111
##   gastritis           0.500000000 0.242857143 0.000000000 0.157142857
##   heart disease       0.531250000 0.203125000 0.000000000 0.218750000
##   HIV/AIDS            0.346153846 0.307692308 0.038461538 0.192307692
##   hypertension        0.548223350 0.208121827 0.000000000 0.126903553
##   kidney disease      0.562043796 0.233576642 0.007299270 0.116788321
##   multiple sclerosis  0.649350649 0.155844156 0.012987013 0.103896104
##   prostate cancer     0.557251908 0.198473282 0.000000000 0.145038168
##   schizophrenia       0.475000000 0.225000000 0.000000000 0.100000000
##   skin cancer         0.556886228 0.185628743 0.000000000 0.137724551
##                      education
```

```
## Y                          phd/md      phD/MD
##   Alzheimer's disease 0.086206897 0.000000000
##   breast cancer       0.076190476 0.000000000
##   diabetes            0.072289157 0.000000000
##   endometriosis       0.133333333 0.000000000
##   gastritis           0.071428571 0.028571429
##   heart disease       0.046875000 0.000000000
##   HIV/AIDS            0.096153846 0.019230769
##   hypertension        0.111675127 0.005076142
##   kidney disease      0.072992701 0.007299270
##   multiple sclerosis  0.064935065 0.012987013
##   prostate cancer     0.099236641 0.000000000
##   schizophrenia       0.125000000 0.075000000
##   skin cancer         0.119760479 0.000000000
##
##                        marital_status
## Y                          married    single
##   Alzheimer's disease 0.7931034 0.2068966
##   breast cancer       0.8000000 0.2000000
##   diabetes            0.7590361 0.2409639
##   endometriosis       0.7777778 0.2222222
##   gastritis           0.7428571 0.2571429
##   heart disease       0.5937500 0.4062500
##   HIV/AIDS            0.6923077 0.3076923
##   hypertension        0.7664975 0.2335025
##   kidney disease      0.7153285 0.2846715
##   multiple sclerosis  0.7272727 0.2727273
##   prostate cancer     0.7175573 0.2824427
##   schizophrenia       0.7500000 0.2500000
##   skin cancer         0.7485030 0.2514970
##
##                        ancestry
## Y                          Austria    Belgium Czech Republic    Denmark
##   Alzheimer's disease 0.04310345 0.05172414     0.03017241 0.08189655
##   breast cancer       0.06666667 0.04761905     0.05714286 0.03809524
##   diabetes            0.04819277 0.02409639     0.02409639 0.06024096
##   endometriosis       0.04444444 0.02222222     0.08888889 0.06666667
##   gastritis           0.10000000 0.02857143     0.01428571 0.05714286
##   heart disease       0.04687500 0.06250000     0.07812500 0.03125000
##   HIV/AIDS            0.03846154 0.05769231     0.03846154 0.00000000
##   hypertension        0.05076142 0.04568528     0.05076142 0.04568528
##   kidney disease      0.06569343 0.04379562     0.05839416 0.04379562
##   multiple sclerosis  0.02597403 0.05194805     0.02597403 0.07792208
##   prostate cancer     0.05343511 0.07633588     0.02290076 0.03816794
##   schizophrenia       0.05000000 0.05000000     0.05000000 0.02500000
##   skin cancer         0.04790419 0.08383234     0.05389222 0.04191617
##                        ancestry
## Y                          England    Finland     France    Germany    Hunga
ry
##   Alzheimer's disease 0.03448276 0.05172414 0.04741379 0.05172414 0.047413
```

```
79
##   breast cancer       0.04761905 0.03809524 0.04761905 0.02857143 0.047619
05
##   diabetes            0.06024096 0.02409639 0.08433735 0.02409639 0.024096
39
##   endometriosis       0.02222222 0.06666667 0.04444444 0.04444444 0.044444
44
##   gastritis           0.05714286 0.01428571 0.04285714 0.05714286 0.014285
71
##   heart disease       0.03125000 0.03125000 0.06250000 0.09375000 0.062500
00
##   HIV/AIDS            0.03846154 0.07692308 0.00000000 0.07692308 0.076923
08
##   hypertension        0.06598985 0.04060914 0.02538071 0.05076142 0.050761
42
##   kidney disease      0.08029197 0.03649635 0.05109489 0.03649635 0.036496
35
##   multiple sclerosis  0.07792208 0.05194805 0.07792208 0.02597403 0.077922
08
##   prostate cancer     0.05343511 0.06870229 0.03053435 0.05343511 0.038167
94
##   schizophrenia       0.05000000 0.02500000 0.00000000 0.10000000 0.025000
00
##   skin cancer         0.05389222 0.04790419 0.05988024 0.05988024 0.041916
17
##                        ancestry
## Y                         Ireland      Italy Netherlands     Poland   Portu
gal
##   Alzheimer's disease 0.05172414 0.05172414  0.04310345 0.06034483 0.04310
345
##   breast cancer       0.01904762 0.06666667  0.04761905 0.06666667 0.10476
190
##   diabetes            0.10843373 0.08433735  0.07228916 0.07228916 0.02409
639
##   endometriosis       0.06666667 0.02222222  0.02222222 0.04444444 0.00000
000
##   gastritis           0.11428571 0.02857143  0.04285714 0.05714286 0.07142
857
##   heart disease       0.07812500 0.09375000  0.06250000 0.04687500 0.01562
500
##   HIV/AIDS            0.07692308 0.03846154  0.05769231 0.00000000 0.05769
231
##   hypertension        0.05076142 0.02030457  0.05583756 0.08629442 0.06091
371
##   kidney disease      0.04379562 0.05109489  0.05839416 0.05109489 0.04379
562
##   multiple sclerosis  0.05194805 0.01298701  0.06493506 0.02597403 0.09090
909
##   prostate cancer     0.04580153 0.09160305  0.05343511 0.03816794 0.07633
588
```

```
##   schizophrenia       0.02500000 0.02500000  0.05000000 0.07500000 0.05000
000
##   skin cancer         0.08383234 0.04790419  0.06586826 0.02994012 0.04790
419
##                      ancestry
## Y                          Russia   Scotland      Spain     Sweden Switzerl
and
##   Alzheimer's disease 0.07327586 0.05603448 0.03448276 0.03879310  0.07327
586
##   breast cancer       0.06666667 0.01904762 0.02857143 0.04761905  0.06666
667
##   diabetes            0.06024096 0.03614458 0.01204819 0.10843373  0.02409
639
##   endometriosis       0.02222222 0.06666667 0.04444444 0.08888889  0.08888
889
##   gastritis           0.01428571 0.02857143 0.01428571 0.11428571  0.07142
857
##   heart disease       0.03125000 0.03125000 0.01562500 0.04687500  0.03125
000
##   HIV/AIDS            0.01923077 0.07692308 0.05769231 0.05769231  0.07692
308
##   hypertension        0.04060914 0.03045685 0.07106599 0.05583756  0.05583
756
##   kidney disease      0.05109489 0.04379562 0.05839416 0.05109489  0.07299
270
##   multiple sclerosis  0.03896104 0.07792208 0.03896104 0.02597403  0.05194
805
##   prostate cancer     0.03816794 0.04580153 0.05343511 0.04580153  0.04580
153
##   schizophrenia       0.10000000 0.00000000 0.15000000 0.02500000  0.10000
000
##   skin cancer         0.02994012 0.02994012 0.04191617 0.05389222  0.05389
222
##                      ancestry
## Y                        Ukraine
##   Alzheimer's disease 0.03448276
##   breast cancer       0.04761905
##   diabetes            0.02409639
##   endometriosis       0.08888889
##   gastritis           0.05714286
##   heart disease       0.04687500
##   HIV/AIDS            0.07692308
##   hypertension        0.04568528
##   kidney disease      0.02189781
##   multiple sclerosis  0.02597403
##   prostate cancer     0.03053435
##   schizophrenia       0.02500000
##   skin cancer         0.02395210
```

Performance

Probabilities for the response variable based on the test data were assigned using the predict function.

```
probs <- predict(fit, type = "response")
pred <- predict(fit, newdata = TestSet)
pred

##         7         8         9        10        14        19        
20 
## 1.2751480 2.1384476 1.7726179 1.7757150 2.2674994 1.4067777 1.99607
44 
##        22        24        25        27        33        39        
40 
## 2.3910580 1.7395332 2.2674994 2.4806032 1.0643005 0.6467856 0.75801
47 
##        41        43        44        45        46        49        
52 
## 1.7591920 1.3255753 1.6288563 1.7579081 2.1438841 1.6641972 0.87097
09 
##        54        57        58        60        68        71        
74 
## 1.8679219 1.6068155 1.6964746 1.6627590 2.0066189 1.3263748 1.64020
29 
##        75        80        84        86        89        93        
99 
## 1.7908262 2.0614740 1.1855444 1.7917053 1.7911478 1.9779680 1.99607
44 
##       103       104       108       111       112       113       1
17 
## 2.2089253 1.0891115 1.8334317 2.3583868 1.6539188 2.0776216 1.90365
06 
##       119       121       122       126       132       134       1
35 
## 1.1424398 2.2216358 0.8750230 1.2548008 0.9762352 0.7584680 1.17652
02 
##       138       139       140       141       148       151       1
52 
## 2.3580652 1.3961573 1.9779680 1.9170154 2.2379661 1.5245460 0.92835
14 
##       160       162       167       168       171       172       1
78 
## 1.4505382 1.3984728 1.1581396 1.4107290 1.4107290 2.0693918 1.53925
28 
##       181       185       188       189       190       191       1
95 
## 1.5712086 1.8700234 1.3576628 2.5952692 1.0470097 2.2850694 1.95220
77 
##       199       206       210       217       218       220       2
```

```
31
##  1.3266971  1.2464332  1.1847059  1.0150539  1.5490726  1.7754781  1.34440
43
##        235        236        238        239        243        245        2
52
##  1.2684055  2.2060103  2.3903426  1.8495793  1.2548008  0.7584680  2.07762
16
##        260        265        269        271        275        280        2
84
##  1.2388728  1.2675068  1.9740167  1.8359661  2.2379661  1.3433974  1.91793
00
##        292        294        295        303        306        307        3
11
##  0.7583363  1.2464332  2.2144080  1.7575627  1.9740167  0.9573070  1.75919
20
##        312        319        320        323        326        330        3
31
##  2.3583868  1.8494526  1.9054600  1.4107290  2.2147296  2.3644804  1.97369
51
##        333        343        344        358        360        361        3
67
##  1.2708286  1.9522077  2.7005424  2.3275696  1.5565018  1.6288563  1.38929
71
##        368        369        370        373        377        379        3
80
##  1.4806264  1.5192806  2.2850694  2.0454652  1.8700234  1.6618970  1.81585
65
##        385        388        391        392        399        405        4
07
##  1.8279262  1.1583679  1.5565018  1.1403384  1.6674466  1.1855444  1.72837
48
##        414        415        417        424        426        427        4
38
##  1.6858746  1.2548008  1.2355510  2.0862364  1.7591920  1.7847392  1.80147
59
##        439        443        446        450        451        452        4
53
##  1.2367713  1.6357751  0.8750230  1.4486706  1.3896186  1.0470097  1.33000
31
##        462        475        483        485        491        494        4
96
##  1.6964746  2.0454652  1.7808074  2.2156598  1.7757150  2.2305556  1.55650
18
##        497        498        500        507        509        512        5
15
##  0.9603072  2.1704034  1.2291423  1.4108641  2.4037685  2.2379661  2.39090
01
##        524        525        531        533        534        539        5
40
##  1.2175002  1.3748219  1.8493530  1.2166617  1.5392528  1.6387713  0.92535
```

```
12
##       541       542       545       547       552       555         5
63
## 1.8815351 2.2994552 1.5490726 1.5908068 1.5275462 15.6935962 1.46512
73
##       565       569       570       572       579       580         5
81
## 1.3263748 0.6148298 1.3575311 2.1781217 2.1019051 2.4486474 2.26000
69
##       584       588       590       593       597       603         6
06
## 1.9889338 1.6683046 2.5952692 0.6148298 1.7983775 1.7911478 1.81669
50
##       607       613       615       617       618       622         6
24
## 1.2612299 2.0862364 1.7978462 1.6850217 2.3429546 2.2379661 1.85399
56
##       625       627       632       633       634       636         6
37
## 1.7209288 1.8463299 1.6855530 2.2994552 1.4644254 1.5199825 1.96411
86
##       652       658       675       676       677       678         6
83
## 1.7169775 1.9578477 1.5650006 2.0542806 1.3539974 1.6850217 2.35894
43
##       688       689       692       693       701       702         7
07
## 2.0059725 0.9582057 2.7005424 1.6387713 1.5561802 2.0995273 16.26808
23
##       715       716       718       719       721       722         7
25
## 1.3961573 1.1583679 1.1855444 1.6288563 2.0059725 1.5908068 1.57120
86
##       726       727       728       729       730       739         7
40
## 1.9575254 0.4479467 2.1710664 1.4108641 1.6634953 2.1566807 1.78473
92
##       741       745       746       748       749       760         7
61
## 1.9779680 0.7548026 1.7169775 1.2459804 2.0225659 1.2292741 0.84807
16
##       762       763       766       767       771       773         7
74
## 1.5718716 0.8709709 0.7583363 2.4799461 1.6387713 1.8868449 1.85399
56
##       777       779       787       790       791       792         8
07
## 1.8356445 2.0199807 1.1583679 1.3787732 2.0636202 1.6227626 0.59799
18
##       816       819       822       826       829       830         8
```

```
31
##  1.9641186  1.5275462  1.6850217  1.6227626  2.2379661  1.7002604  1.55748
59
##        834        836        845        847        848        855        8
59
##  1.4742178  1.4943738  1.5712086  0.6299476  1.5675887  1.6555120  0.95730
70
##        863        868        869        875        882        885        8
87
##  1.0653240  0.8741845  2.5952692  1.5490726  2.2408811  1.2175002  2.39034
26
##        888        889        890        891        892        901        9
11
##  1.6677309  2.2527920  2.2219574  1.8380676  1.6994024  1.5245460  1.35399
74
##        913        914        915        918        921        922        9
26
##  1.3961573  1.3896186  1.6914298  1.9522077  1.2802854  1.8815351  1.28675
66
##        930        932        933        934        938        950        9
51
##  1.2802854  1.7395332  2.3910580  2.2850694  1.4107290  1.0653240  0.79042
38
##        953        958        961        963        974        975        9
76
##  2.2842165  1.9202519  2.1000637  1.0882730  2.1152446  1.4151788  1.33000
31
##        979        990        991        992       1002       1007       10
10
##  1.3745003  1.6227626  2.2600069  1.2471351  1.0972798  2.2619538  1.83375
33
##       1015       1016       1017       1020       1023       1024       10
27
##  1.7917053  1.5392528  2.2531136  1.2367713  1.4486706  1.8334317  1.49437
38
##       1029       1032       1035       1037       1042       1049       10
54
##  2.1883099  1.7983775  1.9960744  1.6393644  1.4108641  1.3753532  2.29945
52
##       1055       1058       1060       1064       1066       1069       10
71
##  1.5392528  1.6683046  1.6905311  2.0941005  1.6082471  1.4624181  1.75919
20
##       1075       1076       1077       1080       1082       1086       10
87
##  1.2708286  1.9415606  2.4805036  1.6683046  2.5162102  1.1847059  1.53925
28
##       1090       1091       1093       1094       1096       1097       10
98
##  1.7283748  0.9283514  1.1847059  1.4108641  1.9880249  2.3909001  1.26872
```

```
71
##      1101      1110      1113      1114      1129      1130        11
34
## 2.1900016 1.7591920 1.2287314 2.3749104 1.7847392 2.2138504 1.97209
68
##      1137      1140      1144      1150      1151      1158        11
67
## 1.6594740 1.0972798 1.9779680 1.8380676 1.2708286 2.1384476 0.44781
49
##      1183      1185      1189      1192      1196      1201        12
03
## 1.4873248 1.3266971 1.2548008 2.0099238 2.0910072 2.2850694 2.13844
76
##      1204      1205      1206      1211      1214      1220        12
23
## 1.3492742 0.9582057 0.8708391 1.8158565 1.8380676 1.7512742 2.23055
56
##      1224      1231      1233      1237      1239      1240        12
43
## 1.9880249 1.7664217 1.8356445 2.3589443 1.8815351 1.6563505 1.68830
63
##      1250      1251      1254      1258      1260      1261        12
69
## 2.4230138 2.0358067 0.9069788 2.1391106 2.0542806 1.0653240 1.63877
13
##      1273      1276      1280      1281      1284      1289        12
91
## 1.7352654 2.1818946 2.1597791 1.6313608 1.8380676 1.5754300 1.27430
94
##      1294      1303      1309      1318      1319      1330        13
33
## 1.9779680 2.1704034 0.4478149 0.9250296 1.7435223 1.5245460 2.37491
04
##      1341      1343      1352      1353      1355      1359        13
60
## 1.3787732 1.2166617 1.5925401 1.5712086 2.2531136 0.9573070 2.51944
67
##      1369      1371      1375      1376      1377      1386        13
89
## 2.0803787 1.1811707 1.5712086 2.1019051 1.6517556 1.5565018 1.23677
13
##      1390      1404      1405      1406      1409      1410        14
12
## 1.5810284 1.7597495 1.4949057 1.1847059 1.2131265 2.0776216 1.90420
82
##      1413      1418      1423      1425      1426      1429        14
32
## 1.9410030 1.4067777 1.7911478 1.7839007 1.7911478 1.2134481 1.56500
06
##      1435      1436      1442      1443      1445      1446        14
```

```
55
##  1.9187685  1.8166950  1.4870416  1.0891115  2.0803787  1.3859532  1.97369
51
##       1456       1457       1464       1466       1468       1469        14
70
##  2.0862364  2.3909001  1.0653240  1.6539188  2.0862364  1.6889730  1.07909
72
##       1476       1477       1480       1487       1492       1494        14
96
##  1.5277001  1.4492281  1.9740167  1.3284763  1.0653240  1.2544792  1.91876
85
##       1502       1507       1511       1512       1516       1521        15
23
##  2.0769431  1.6858746  0.6467856  2.1397899  1.9522077  2.1704034  1.79114
78
##       1526       1529       1535       1537       1538       1541        15
42
##  1.3896186  1.8158565  1.1765202  1.0653240  1.4870416  0.5979918  2.26240
75
##       1548       1551       1554       1557       1558       1559        15
62
##  1.8598820  1.5446893  2.2379661  1.2459804  1.6634953  2.5002014  1.40677
77
##       1564       1565       1568       1572       1574       1580        15
81
##  1.9036506  2.0910072  2.2060103  2.5162102  2.2060103  2.0862364  1.98802
49
##       1590       1592       1593       1594       1603       1604        16
06
##  1.8337533  1.3665170  1.6068155  1.6546041  1.6645188  1.5192806  1.95072
43
##       1610       1615       1616       1617       1622       1625        16
26
##  1.5574859  1.8294804  2.3746729  1.2388728  1.7075774  2.2850694  1.87225
24
##       1628       1630       1632       1635       1638       1640        16
42
##  0.4478149  0.7583363  2.0099238  2.3429546  1.5995445  1.5712086  0.75833
63
##       1643       1644       1646       1647       1650       1652        16
54
##  0.6148298  1.6645188  1.7033096  1.2175002  2.0910072  1.2367713 15.96397
61
##       1656       1658       1660       1664       1665       1667        16
68
##  2.0699493  0.7904238  2.4924160  2.0693918  1.3576628  1.2708286  1.57892
69
##       1671       1676       1683       1684       1688       1691        16
93
##  2.3589443  0.4799024  2.3240308  1.6068155  1.8166950  1.2867566  1.88153
```

```
51
##      1697      1699      1702      1703      1707      1710        17
15
## 1.0643005 1.1843843 0.4158591 1.5712086 1.4107290 1.7985481 1.57892
69
##      1716      1717      1719      1726      1736      1741        17
47
## 2.4799461 1.1855444 1.9779680 0.9603072 1.8158565 1.4550858 1.75974
95
##      1749      1750      1757      1759      1761      1766        17
70
## 1.4870416 1.8294804 1.5810284 1.4550858 1.3266971 2.1095774 0.95730
70
##      1774      1776      1777      1779      1788      1789        17
96
## 2.5194467 1.7033096 2.0100589 0.7584680 1.9735164 1.3896186 1.32557
53
##      1797      1800      1802      1807      1813      1814        18
15
## 2.1818946 1.0972798 1.5712086 2.7010999 1.8859514 1.8205824 2.06471
06
##      1818      1827      1829      1830      1831      1842        18
48
## 0.7548026 1.8166950 2.0776216 2.5002014 2.1461659 2.3583868 1.06532
40
##      1853      1856      1858      1860      1861      1865        18
69
## 1.2364497 2.0803787 2.5194467 2.5514025 1.0365803 2.3275696 0.87083
91
##      1870      1874      1876      1878      1881      1883        18
94
## 1.8775838 1.3255753 1.7002604 1.4949057 1.3539974 0.4478149 1.97401
67
##      1895      1897      1899      1900      1904      1905        19
07
## 2.0484229 1.9755549 1.8155349 0.9061403 1.1855444 1.2166617 1.60570
89
##      1908      1909      1911      1914      1922      1929        19
30
## 1.7597495 1.2687271 1.5192806 1.6674466 2.0099238 1.1490832 1.40747
96
##      1932      1935      1938      1940      1950      1951        19
55
## 1.4880267 2.0040526 1.3300031 2.0199807 0.9262499 1.6858746 1.55740
05
##      1958      1964      1973      1975      1977      1980        19
82
## 2.2408811 2.1802232 2.0358067 1.9779680 2.5194467 1.8238190 1.57120
86
```

```
##       1987      1988      1992      1996      1999
##  1.8158565 1.6858746 2.3903426 0.9688911 1.2166617
```

Confusion Matrix

```
#confusionMatrix(pred, TestSet$disease)
```

Random forest model

Apply random forest model

```
# Fine tuning parameters of Random Forest model
model2 <- randomForest(disease ~ ., data = disease_TrainSet,  importance = TR
UE)
model2

##
## Call:
##  randomForest(formula = disease ~ ., data = disease_TrainSet,      importa
nce = TRUE)
##                Type of random forest: classification
##                      Number of trees: 500
## No. of variables tried at each split: 2
##
##         OOB estimate of  error rate: 83.57%
## Confusion matrix:
##                      Alzheimer's disease breast cancer diabetes endometrios
is
## Alzheimer's disease                  83            39        1
2
## breast cancer                        30            37        0
0
## diabetes                             31             9        0
1
## endometriosis                        13            13        1
0
## gastritis                            21            14        0
0
## heart disease                        15             9        0
1
## HIV/AIDS                              7             8        0
1
## hypertension                         59            32        0
0
## kidney disease                       30            23        1
2
## multiple sclerosis                   28            16        0
0
## prostate cancer                      60             0        0
0
## schizophrenia                        12             6        0
```

```
0
## skin cancer                          63            22        1
1
##                       gastritis heart disease HIV/AIDS hypertension
## Alzheimer's disease           0             4        0           28
## breast cancer                 0             0        0           17
## diabetes                      0             0        1            8
## endometriosis                 0             0        1            6
## gastritis                     0             0        1           13
## heart disease                 0             0        0            9
## HIV/AIDS                      1             0        1            3
## hypertension                  1             1        1           24
## kidney disease                0             1        2           11
## multiple sclerosis            1             0        0            6
## prostate cancer               0             1        2            7
## schizophrenia                 2             0        0            6
## skin cancer                   0             1        1           16
##                       kidney disease multiple sclerosis prostate cancer
## Alzheimer's disease                8                  2              40
## breast cancer                      8                  1               0
## diabetes                           5                  0              20
## endometriosis                      4                  0               0
## gastritis                          1                  0              15
## heart disease                      4                  0              22
## HIV/AIDS                           3                  0              22
## hypertension                      11                  0              46
## kidney disease                    14                  3              39
## multiple sclerosis                 3                  0              16
## prostate cancer                    2                  1              55
## schizophrenia                      0                  1              10
## skin cancer                        6                  0              40
##                       schizophrenia skin cancer class.error
## Alzheimer's disease               0          25   0.6422414
## breast cancer                     0          12   0.6476190
## diabetes                          0           8   1.0000000
## endometriosis                     0           7   1.0000000
## gastritis                         2           3   1.0000000
## heart disease                     0           4   1.0000000
## HIV/AIDS                          1           5   0.9807692
## hypertension                      1          21   0.8781726
## kidney disease                    0          11   0.8978102
## multiple sclerosis                1           6   1.0000000
## prostate cancer                   0           3   0.5801527
## schizophrenia                     0           3   1.0000000
## skin cancer                       0          16   0.9041916

# Predicting on train set
predTrain <- predict(model2, disease_TrainSet, type = "class")
```

```r
# Checking classification accuracy
table(predTrain, disease_TrainSet$disease)

##
## predTrain             Alzheimer's disease breast cancer diabetes endometri
osis
##   Alzheimer's disease                 137            14       32
11
##   breast cancer                        29            67        8
14
##   diabetes                              1             0        9
0
##   endometriosis                         1             0        1
3
##   gastritis                             0             0        0
0
##   heart disease                         1             0        0
0
##   HIV/AIDS                              0             0        1
1
##   hypertension                         14             9        5
5
##   kidney disease                        6             4        4
4
##   multiple sclerosis                    0             0        0
0
##   prostate cancer                      31             0       19
0
##   schizophrenia                         0             0        0
0
##   skin cancer                          12            11        4
7
##
## predTrain             gastritis heart disease HIV/AIDS hypertension
##   Alzheimer's disease        20            14        4           48
##   breast cancer              12             9       10           24
##   diabetes                    0             0        0            0
##   endometriosis               0             0        1            0
##   gastritis                   6             0        0            0
##   heart disease               0             8        0            0
##   HIV/AIDS                    1             1       13            1
##   hypertension               11             5        2           73
##   kidney disease              2             2        1            4
##   multiple sclerosis          0             0        0            0
##   prostate cancer            14            22       17           32
##   schizophrenia               0             0        0            0
##   skin cancer                 4             3        4           15
##
## predTrain             kidney disease multiple sclerosis prostate cancer
##   Alzheimer's disease             32                 28              43
```

```
##   breast cancer                   19                  14                0
##   diabetes                         0                   0                0
##   endometriosis                    0                   0                0
##   gastritis                        0                   0                0
##   heart disease                    0                   0                0
##   HIV/AIDS                         1                   0                0
##   hypertension                     9                   4                2
##   kidney disease                  34                   3                0
##   multiple sclerosis               0                   6                0
##   prostate cancer                 35                  16               85
##   schizophrenia                    0                   0                0
##   skin cancer                      7                   6                1
##
## predTrain             schizophrenia skin cancer
##   Alzheimer's disease            13          43
##   breast cancer                   6          19
##   diabetes                        0           0
##   endometriosis                   0           1
##   gastritis                       1           0
##   heart disease                   0           0
##   HIV/AIDS                        0           0
##   hypertension                    6          14
##   kidney disease                  0           6
##   multiple sclerosis              1           0
##   prostate cancer                 9          35
##   schizophrenia                   2           0
##   skin cancer                     2          49

model2 <- na.omit(model2)

# Predicting on Validation set
predValid <- predict(model2, disease_TestSet, type = "class")

# Checking classification accuracy
mean(predValid == disease_TestSet$disease)

## [1] 0.165

table(predValid,disease_TestSet$disease)

##
## predValid             Alzheimer's disease breast cancer diabetes endometri
osis
##   Alzheimer's disease                  39            13       17
9
##   breast cancer                        18            11        4
8
##   diabetes                              1             0        0
0
##   endometriosis                         0             0        0
0
```

```
##   gastritis                            0             0        0
0
##   heart disease                        0             0        0
0
##   HIV/AIDS                             1             1        0
1
##   hypertension                         6             4        9
2
##   kidney disease                       7             5        1
0
##   multiple sclerosis                   0             0        0
0
##   prostate cancer                     28             0        4
0
##   schizophrenia                        0             0        0
0
##   skin cancer                          7             6        1
1
##
## predValid              gastritis heart disease HIV/AIDS hypertension
##   Alzheimer's disease         10             9        2           27
##   breast cancer                3             1        3           21
##   diabetes                     0             1        0            0
##   endometriosis                0             0        0            0
##   gastritis                    1             0        0            0
##   heart disease                0             1        0            1
##   HIV/AIDS                     0             0        0            2
##   hypertension                 3             1        2           10
##   kidney disease               3             2        1            6
##   multiple sclerosis           0             0        0            1
##   prostate cancer              9             4       12           20
##   schizophrenia                0             0        0            0
##   skin cancer                  1             4        8           13
##
## predValid              kidney disease multiple sclerosis prostate cancer
##   Alzheimer's disease              17                 12              15
##   breast cancer                     8                  5               0
##   diabetes                          0                  0               0
##   endometriosis                     0                  0               0
##   gastritis                         0                  0               0
##   heart disease                     1                  0               1
##   HIV/AIDS                          0                  0               0
##   hypertension                      7                  4               3
##   kidney disease                    4                  2               1
##   multiple sclerosis                0                  0               0
##   prostate cancer                  10                 12              29
##   schizophrenia                     0                  0               0
##   skin cancer                       1                  1               0
##
## predValid              schizophrenia skin cancer
```

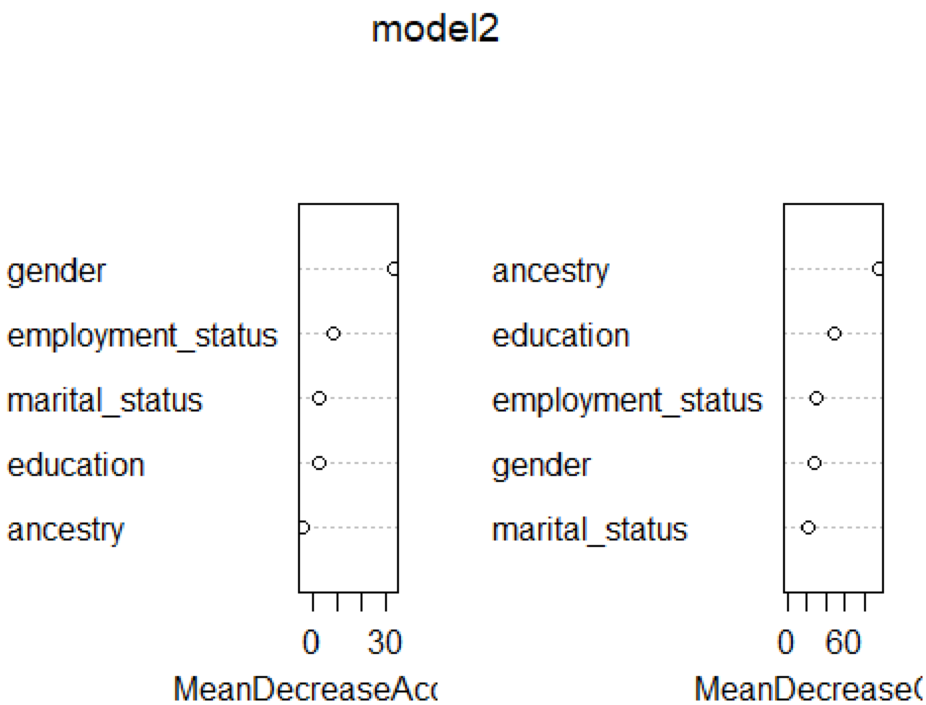
```
##   Alzheimer's disease            6          27
##   breast cancer                  3          13
##   diabetes                       0           0
##   endometriosis                  0           1
##   gastritis                      0           1
##   heart disease                  0           1
##   HIV/AIDS                       1           1
##   hypertension                   0           3
##   kidney disease                 0           3
##   multiple sclerosis             0           0
##   prostate cancer                4          12
##   schizophrenia                  0           0
##   skin cancer                    1           4

# To check important variables
importance(model2)

##                     Alzheimer's disease breast cancer  diabetes endometriosi
s
## gender                        -1.572030     29.337689 -2.372525      7.31396
3
## employment_status              8.261509     -3.560134  2.802048     -3.25048
8
## education                     -7.859652      1.624276  3.229921      0.24609
6
## marital_status                -1.170440     -4.579872  6.081446      3.69514
5
## ancestry                      -4.582599     -7.807351  5.144771     -2.21798
9
##                      gastritis heart disease   HIV/AIDS hypertension
## gender              -0.7361897      1.920755  3.5379679    1.4733691
## employment_status   -1.4860458     -2.759647  4.9418385    2.9941151
## education           -6.0412280      2.067650  3.3755598    1.2388433
## marital_status       0.8802722      5.436578 -0.8679253    1.6938141
## ancestry            -1.4805477     -2.740245  2.7803375    0.2844226
##                     kidney disease multiple sclerosis prostate cancer
## gender                    9.248339           1.999961      38.3640487
## employment_status        10.049442          -9.329930       0.1440121
## education                 6.218238          -2.672903       4.7016289
## marital_status            9.817900          -2.472035      -5.8784037
## ancestry                  3.755459          -1.120006      -5.9362590
##                     schizophrenia skin cancer MeanDecreaseAccuracy
## gender                  -7.290833    5.416934            33.929733
## employment_status        2.122147    4.818350             8.330237
## education                2.701801    4.801611             2.465961
## marital_status          -5.176843    7.090811             2.618061
## ancestry                -1.959080    3.297698            -4.563110
##                     MeanDecreaseGini
## gender                      27.81891
## employment_status           29.50241
```

```
## education                     48.83914
## marital_status                21.16534
## ancestry                      95.14737

varImpPlot(model2)
```



Naive Bayes Model

```
NBclassfier = naiveBayes(disease~., data=disease_TrainSet)
print(NBclassfier)

##
## Naive Bayes Classifier for Discrete Predictors
##
## Call:
## naiveBayes.default(x = X, y = Y, laplace = laplace)
##
## A-priori probabilities:
## Y
## Alzheimer's disease       breast cancer            diabetes        endometr
iosis
##          0.16571429          0.07500000          0.05928571            0.032
14286
##           gastritis       heart disease            HIV/AIDS          hyperte
nsion
##          0.05000000          0.04571429          0.03714286            0.140
71429
##      kidney disease  multiple sclerosis     prostate cancer         schizoph
```

```
renia
##          0.09785714          0.05500000          0.09357143          0.028
57143
##         skin cancer
##          0.11928571
##
## Conditional probabilities:
##                        gender
## Y                          female      male
##   Alzheimer's disease 0.4870690 0.5129310
##   breast cancer       1.0000000 0.0000000
##   diabetes            0.4337349 0.5662651
##   endometriosis       1.0000000 0.0000000
##   gastritis           0.4714286 0.5285714
##   heart disease       0.3906250 0.6093750
##   HIV/AIDS            0.4423077 0.5576923
##   hypertension        0.5025381 0.4974619
##   kidney disease      0.5109489 0.4890511
##   multiple sclerosis  0.4545455 0.5454545
##   prostate cancer     0.0000000 1.0000000
##   schizophrenia       0.4250000 0.5750000
##   skin cancer         0.4670659 0.5329341
##
##                        employment_status
## Y                          employed     retired     student  unemployed
##   Alzheimer's disease 0.288793103 0.586206897 0.004310345 0.120689655
##   breast cancer       0.390476190 0.485714286 0.009523810 0.114285714
##   diabetes            0.313253012 0.530120482 0.012048193 0.144578313
##   endometriosis       0.288888889 0.533333333 0.000000000 0.177777778
##   gastritis           0.428571429 0.371428571 0.042857143 0.157142857
##   heart disease       0.453125000 0.390625000 0.000000000 0.156250000
##   HIV/AIDS            0.673076923 0.115384615 0.019230769 0.192307692
##   hypertension        0.345177665 0.517766497 0.010152284 0.126903553
##   kidney disease      0.489051095 0.364963504 0.007299270 0.138686131
##   multiple sclerosis  0.363636364 0.493506494 0.025974026 0.116883117
##   prostate cancer     0.381679389 0.488549618 0.000000000 0.129770992
##   schizophrenia       0.350000000 0.500000000 0.075000000 0.075000000
##   skin cancer         0.407185629 0.526946108 0.000000000 0.065868263
##
##                        education
## Y                         bachelors  highschool   highscool     masters
##   Alzheimer's disease 0.508620690 0.245689655 0.000000000 0.159482759
##   breast cancer       0.580952381 0.190476190 0.000000000 0.152380952
##   diabetes            0.481927711 0.313253012 0.000000000 0.132530120
##   endometriosis       0.533333333 0.222222222 0.000000000 0.111111111
##   gastritis           0.500000000 0.242857143 0.000000000 0.157142857
##   heart disease       0.531250000 0.203125000 0.000000000 0.218750000
##   HIV/AIDS            0.346153846 0.307692308 0.038461538 0.192307692
##   hypertension        0.548223350 0.208121827 0.000000000 0.126903553
##   kidney disease      0.562043796 0.233576642 0.007299270 0.116788321
```

```
##   multiple sclerosis  0.649350649 0.155844156 0.012987013 0.103896104
##   prostate cancer     0.557251908 0.198473282 0.000000000 0.145038168
##   schizophrenia       0.475000000 0.225000000 0.000000000 0.100000000
##   skin cancer         0.556886228 0.185628743 0.000000000 0.137724551
##                      education
## Y                          phd/md      phD/MD
##   Alzheimer's disease 0.086206897 0.000000000
##   breast cancer       0.076190476 0.000000000
##   diabetes            0.072289157 0.000000000
##   endometriosis       0.133333333 0.000000000
##   gastritis           0.071428571 0.028571429
##   heart disease       0.046875000 0.000000000
##   HIV/AIDS            0.096153846 0.019230769
##   hypertension        0.111675127 0.005076142
##   kidney disease      0.072992701 0.007299270
##   multiple sclerosis  0.064935065 0.012987013
##   prostate cancer     0.099236641 0.000000000
##   schizophrenia       0.125000000 0.075000000
##   skin cancer         0.119760479 0.000000000
##
##                      marital_status
## Y                       married    single
##   Alzheimer's disease 0.7931034 0.2068966
##   breast cancer       0.8000000 0.2000000
##   diabetes            0.7590361 0.2409639
##   endometriosis       0.7777778 0.2222222
##   gastritis           0.7428571 0.2571429
##   heart disease       0.5937500 0.4062500
##   HIV/AIDS            0.6923077 0.3076923
##   hypertension        0.7664975 0.2335025
##   kidney disease      0.7153285 0.2846715
##   multiple sclerosis  0.7272727 0.2727273
##   prostate cancer     0.7175573 0.2824427
##   schizophrenia       0.7500000 0.2500000
##   skin cancer         0.7485030 0.2514970
##
##                      ancestry
## Y                         Austria    Belgium Czech Republic    Denmark
##   Alzheimer's disease 0.04310345 0.05172414     0.03017241 0.08189655
##   breast cancer       0.06666667 0.04761905     0.05714286 0.03809524
##   diabetes            0.04819277 0.02409639     0.02409639 0.06024096
##   endometriosis       0.04444444 0.02222222     0.08888889 0.06666667
##   gastritis           0.10000000 0.02857143     0.01428571 0.05714286
##   heart disease       0.04687500 0.06250000     0.07812500 0.03125000
##   HIV/AIDS            0.03846154 0.05769231     0.03846154 0.00000000
##   hypertension        0.05076142 0.04568528     0.05076142 0.04568528
##   kidney disease      0.06569343 0.04379562     0.05839416 0.04379562
##   multiple sclerosis  0.02597403 0.05194805     0.02597403 0.07792208
##   prostate cancer     0.05343511 0.07633588     0.02290076 0.03816794
##   schizophrenia       0.05000000 0.05000000     0.05000000 0.02500000
```

```
##   skin cancer         0.04790419 0.08383234     0.05389222 0.04191617
##                        ancestry
## Y                          England    Finland     France    Germany    Hunga
ry
##   Alzheimer's disease 0.03448276 0.05172414 0.04741379 0.05172414 0.047413
79
##   breast cancer       0.04761905 0.03809524 0.04761905 0.02857143 0.047619
05
##   diabetes            0.06024096 0.02409639 0.08433735 0.02409639 0.024096
39
##   endometriosis       0.02222222 0.06666667 0.04444444 0.04444444 0.044444
44
##   gastritis           0.05714286 0.01428571 0.04285714 0.05714286 0.014285
71
##   heart disease       0.03125000 0.03125000 0.06250000 0.09375000 0.062500
00
##   HIV/AIDS            0.03846154 0.07692308 0.00000000 0.07692308 0.076923
08
##   hypertension        0.06598985 0.04060914 0.02538071 0.05076142 0.050761
42
##   kidney disease      0.08029197 0.03649635 0.05109489 0.03649635 0.036496
35
##   multiple sclerosis  0.07792208 0.05194805 0.07792208 0.02597403 0.077922
08
##   prostate cancer     0.05343511 0.06870229 0.03053435 0.05343511 0.038167
94
##   schizophrenia       0.05000000 0.02500000 0.00000000 0.10000000 0.025000
00
##   skin cancer         0.05389222 0.04790419 0.05988024 0.05988024 0.041916
17
##                        ancestry
## Y                          Ireland      Italy Netherlands     Poland   Portu
gal
##   Alzheimer's disease 0.05172414 0.05172414  0.04310345 0.06034483 0.04310
345
##   breast cancer       0.01904762 0.06666667  0.04761905 0.06666667 0.10476
190
##   diabetes            0.10843373 0.08433735  0.07228916 0.07228916 0.02409
639
##   endometriosis       0.06666667 0.02222222  0.02222222 0.04444444 0.00000
000
##   gastritis           0.11428571 0.02857143  0.04285714 0.05714286 0.07142
857
##   heart disease       0.07812500 0.09375000  0.06250000 0.04687500 0.01562
500
##   HIV/AIDS            0.07692308 0.03846154  0.05769231 0.00000000 0.05769
231
##   hypertension        0.05076142 0.02030457  0.05583756 0.08629442 0.06091
371
##   kidney disease      0.04379562 0.05109489  0.05839416 0.05109489 0.04379
```

```
562
##   multiple sclerosis  0.05194805 0.01298701  0.06493506 0.02597403 0.09090
909
##   prostate cancer     0.04580153 0.09160305  0.05343511 0.03816794 0.07633
588
##   schizophrenia       0.02500000 0.02500000  0.05000000 0.07500000 0.05000
000
##   skin cancer         0.08383234 0.04790419  0.06586826 0.02994012 0.04790
419
##                        ancestry
## Y                          Russia   Scotland      Spain     Sweden Switzerl
and
##   Alzheimer's disease 0.07327586 0.05603448 0.03448276 0.03879310  0.07327
586
##   breast cancer       0.06666667 0.01904762 0.02857143 0.04761905  0.06666
667
##   diabetes            0.06024096 0.03614458 0.01204819 0.10843373  0.02409
639
##   endometriosis       0.02222222 0.06666667 0.04444444 0.08888889  0.08888
889
##   gastritis           0.01428571 0.02857143 0.01428571 0.11428571  0.07142
857
##   heart disease       0.03125000 0.03125000 0.01562500 0.04687500  0.03125
000
##   HIV/AIDS            0.01923077 0.07692308 0.05769231 0.05769231  0.07692
308
##   hypertension        0.04060914 0.03045685 0.07106599 0.05583756  0.05583
756
##   kidney disease      0.05109489 0.04379562 0.05839416 0.05109489  0.07299
270
##   multiple sclerosis  0.03896104 0.07792208 0.03896104 0.02597403  0.05194
805
##   prostate cancer     0.03816794 0.04580153 0.05343511 0.04580153  0.04580
153
##   schizophrenia       0.10000000 0.00000000 0.15000000 0.02500000  0.10000
000
##   skin cancer         0.02994012 0.02994012 0.04191617 0.05389222  0.05389
222
##                        ancestry
## Y                         Ukraine
##   Alzheimer's disease 0.03448276
##   breast cancer       0.04761905
##   diabetes            0.02409639
##   endometriosis       0.08888889
##   gastritis           0.05714286
##   heart disease       0.04687500
##   HIV/AIDS            0.07692308
##   hypertension        0.04568528
##   kidney disease      0.02189781
##   multiple sclerosis  0.02597403
```

```
##   prostate cancer     0.03053435
##   schizophrenia       0.02500000
##   skin cancer         0.02395210
```