Report on forcast

Loading the libraries

```r
library(readxl)
library(MASS)
library(caret)
library(rpart)
library(rpart.plot)
library(randomForest)
library(glmnet)
library(xgboost)
```

The data

In this data set we set the data one month ahead (if the observations (independent data) are on January of 2019 then the main (dependent) is on Faburary 2019)

Cleaning the data

```r
df <- read_xlsx("ML_ready/data_ML.xlsx")

main <- read_xls("economy.xls", sheet = '2011-2019 NACE 2')

colnames(main) <- main[3,]

main <- main[4,]
main <- main[,c(16:103)]

df = as.data.frame(df)
rownames(df) = df$months
df$months = NULL

df = df[, colSums(df != 0) > 0]
df = df[, (df[86,] != 0) > 0]

df_sum <- colSums(df)
df_sum <- sort(df_sum,decreasing = T)

top_20 = head(df_sum,n = 20)
top_20_names = colnames(t(as.data.frame(top_20)))
top_20_loc = which(colnames(df) %in% top_20_names)

try <- df[, top_20_loc]
try <- try[-c(1:33),]

main <- main[,c(34:88)]
main <- t(main)

names <- colnames(try)
```

```r
colnames(try) <- paste0("name",c(1:20))

try <- try[-c(56,57),]
###########
########### Here we delete the last month of Try and the first month of Main
########### Because we want to predict one month into the future?
try <- try[-c(55),]
main <- main[-1]
###########
###########

try$main <- as.numeric(main)
try$main <- try$main * 100000000 ### Multiply by hundred million
```

Printing the final form of the data

```r
head(try)
```

```
##                 name1   name2 name3 name4      name5   name6   name7
## 2014_OCT    811759.0 2244268     0     0 8568607.00 2990509 4130414
## 2014_NOV    835944.9 2249903     0     0 5739873.00 3258572 4121925
## 2014_DEC    959725.1 2229910     0     0 2058646.00 2711211 3549545
## 2015_JAN    849626.8 2156033     0     0   43373.25 4171518 3013833
## 2015_FEB    741612.9 1871933     0     0   16650.15 2855290 3855382
## 2015_MARCH 1161081.3 2114494     0     0       0.00 3693042 3970585
##               name8  name9  name10   name11  name12 name13  name14  name15
## 2014_OCT   2192361 342413 4464967  9847851 3008645      0       0 2180016
## 2014_NOV   2214470 412123 3765709  9464512 2672553      0 1010326 1248139
## 2014_DEC   2371809 901545 4150028 10270711 2662845      0 2853744       0
## 2015_JAN    506449 244103 3801753 10267426 2539542      0 2842016 4019259
## 2015_FEB   1193319 559894 3455077  8458058 3543618      0 2702967 3680741
## 2015_MARCH 1801947 530894 3793357  8802300 2429327      0 2796296 4621621
##             name16  name17 name18 name19  name20         main
## 2014_OCT        0 2363502      0 895053 3184475 1.203592e+13
## 2014_NOV        0 2302617      0 810880 3082643 1.276962e+13
## 2014_DEC        0 2644527      0 919017 3761799 8.866020e+12
## 2015_JAN        0 2550053      0 186685 3744077 9.936690e+12
## 2015_FEB        0 2023233      0 353564 3617373 1.068529e+13
## 2015_MARCH      0 2200895      0 382379 3645492 1.048763e+13
```

Spliting the data into train*.85 and test*.15

```r
index <- sample(1:nrow(try),round(0.85*nrow(try)))

train <- try[index,]
test <- try[-index,]

n <- names(train)
```

Our formula

```r
f <- as.formula(paste("main ~",paste(n[!n %in% "main"], collapse = " + ")))
```

Prediction Models

Linear Regression

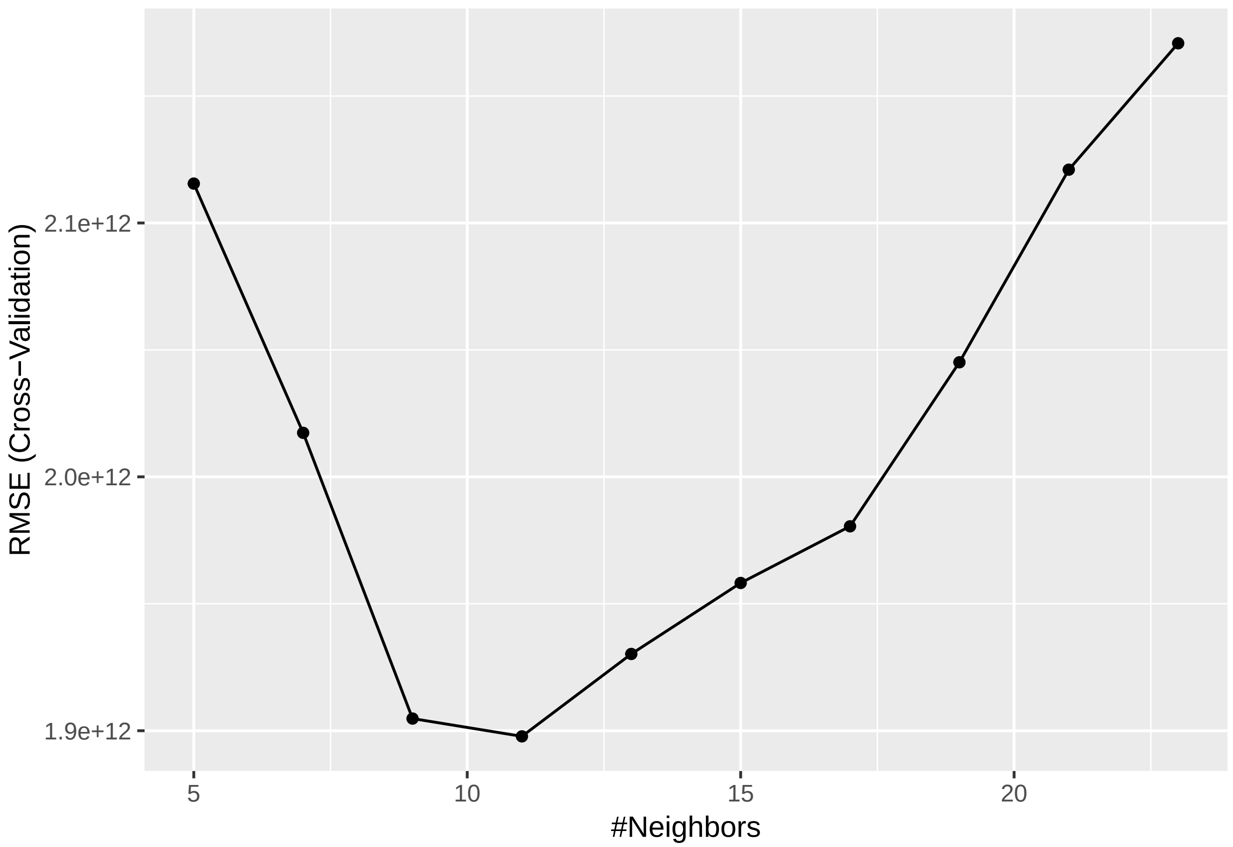
```r
fit <- lm(main~., train)

pred1<-predict(fit, newdata = test)

RMSE1<-RMSE(test$main, pred1)

MAE1 <- MAE(test$main, pred1)
```

```
## [1] "RMSE for Linear Regression: 6478712621862.47"
```

```
## [1] "MAE for Linear Regression: 3355103145950.17"
```

K- Nearest Neighbors

```r
ctrl <- trainControl(method = "cv", number = 10)

knn_c <- train(f, data = train, method = "knn",
               trControl = ctrl, preProcess = c("center", "scale"), tuneLength = 10)
```



```
model_predict_test = predict(knn_c, newdata = test)
which.min(c(sqrt(mean(abs(model_predict_test - test$main)^2)),sqrt(mean((test$main- predict(fit, test))
```

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

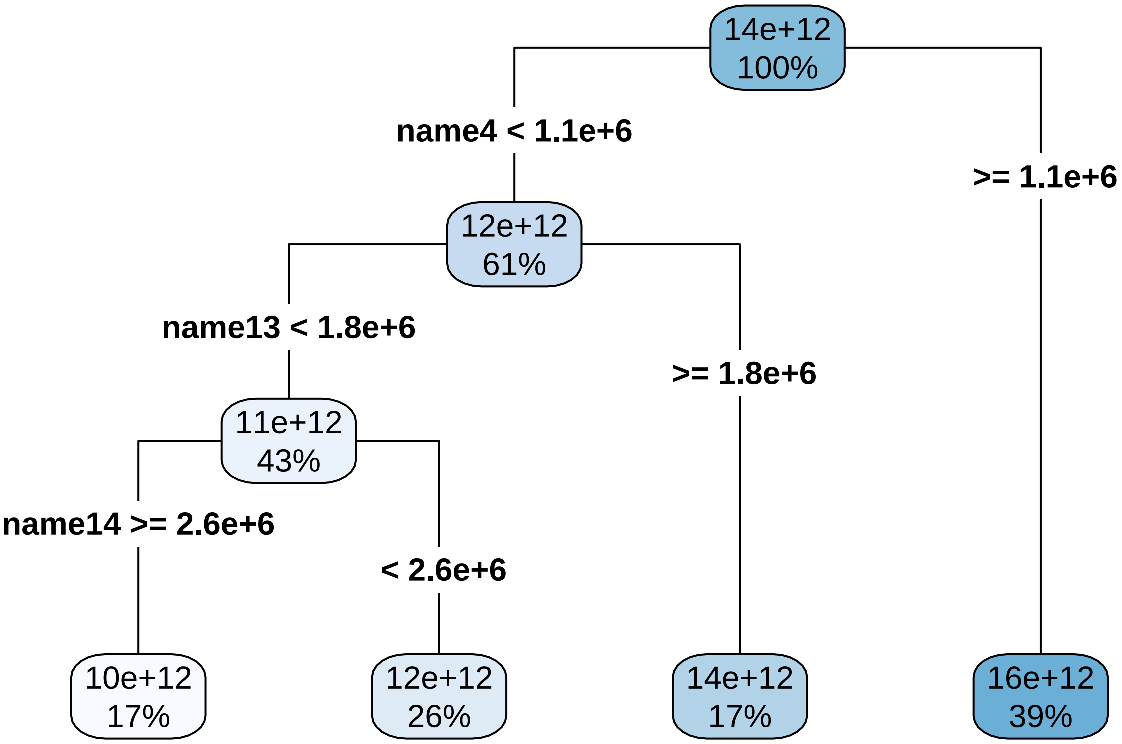
```
RMSE_KNN <- RMSE(test$main, model_predict_test)

MAE_KNN <- MAE(test$main, model_predict_test)
```

```
## [1] "RMSE for KNN: 2120498834762.72"
```

```
## [1] "MAE for KNN: 1554398295454.55"
```

Tree

```
my_model <- rpart(f,subset = index, data= try)
```



```
predictions<-predict(my_model,newdata=test)

RMSE_Tree <- RMSE(predictions, test$main)

MAE_Tree <- MAE(predictions, test$main)
```

```
## [1] "RMSE for Tree: 1856565948984.63"
```

```
## [1] "MAE for Tree: 1480103298611.11"
```

forrest

```
set.seed(1)
bag.black <- randomForest(f,data=try, subset=index,importance =TRUE)

prediction_forest = predict(bag.black, newdata=test[1,])
```

```
getTree(bag.black,1,labelVar=TRUE)
```

```
##   left daughter right daughter split var split point status   prediction
## 1             2              3     name4    1114517.0     -3 1.337844e+13
## 2             4              5     name7    4046255.0     -3 1.232288e+13
## 3             6             7   name11 15899499.5    -3 1.535760e+13
## 4             0             0     <NA>        0.0    -1 1.066943e+13
## 5             8             9   name11 14242278.5    -3 1.265357e+13
## 6             0             0     <NA>        0.0    -1 1.851764e+13
## 7            10            11   name19  1656519.5    -3 1.392122e+13
## 8            12            13    name7  7297726.5    -3 1.225779e+13
## 9             0             0     <NA>        0.0    -1 1.423673e+13
## 10            0             0     <NA>        0.0    -1 1.497139e+13
## 11           14            15   name12  8105113.5    -3 1.304609e+13
## 12           16            17   name19   542930.5    -3 1.203837e+13
## 13            0             0     <NA>        0.0    -1 1.313544e+13
## 14            0             0     <NA>        0.0    -1 1.315661e+13
## 15            0             0     <NA>        0.0    -1 1.249345e+13
## 16            0             0     <NA>        0.0    -1 1.154065e+13
## 17           18            19    name5  1128003.8    -3 1.226461e+13
## 18           20            21   name16   707780.7    -3 1.206811e+13
## 19            0             0     <NA>        0.0    -1 1.250041e+13
## 20            0             0     <NA>        0.0    -1 1.177459e+13
## 21            0             0     <NA>        0.0    -1 1.212681e+13
```

```r
MAE_forest <- MAE(prediction_forest, test$main)
RMSE_forest <- RMSE(prediction_forest, test$main)
```

```
## [1] "RMSE for Random Forrest: 3931069158250.22"
```

```
## [1] "MAE for Random Forrest: 2833187888500"
```

Ridge Regression

```r
x = model.matrix(f, data = try)[,c(-1,-2)]
y = try$main

grid = 10^seq(10,-2, length = 100)

ridge.mod = glmnet(x[index,], y[index], alpha = 0, lambda = grid,
                   thresh = 1e-12)
ridge.pred =predict(ridge.mod, s = 4, newx = x[-index,])

RMSE_ridge <- RMSE(ridge.pred, y[-index])

MAE_ridge <- MAE(ridge.pred, y[-index])
```

```
## [1] "RMSE for Ridge Regression: 5694886002039.19"
```

```
## [1] "MAE for Ridge Regression: 3046345873626.28"
```

Lasso Regression

```
set.seed(1)

lasso.mod=glmnet(x[index,],y[index],alpha=1,lambda=grid)
cv.out=cv.glmnet(x[index,],y[index],alpha=1)

bestlam=cv.out$lambda.min

lasso.pred=predict(lasso.mod,s=bestlam,newx=x[-index,])
RMSE_lasso <- RMSE(lasso.pred, y[-index])

MAE_lasso <- MAE(lasso.pred, y[-index])
```

```
## [1] "RMSE for Lasso Regression: 5628571121840.2"
```

```
## [1] "MAE for Lasso Regression: 2993412344469.19"
```

Extreme Gradient Boosting

```
set.seed(1)
dtrain2 <- xgb.DMatrix(data = x[index,], label = y[index])
dtest2 <- xgb.DMatrix(data = x[-index,], label = y[-index])
watchlist <- list(train= dtrain2, test= dtest2)
set.seed(1)
bst2 <- xgb.train(data= dtrain2, max.depth=20, eta=0.09, nrounds=120,watchlist=watchlist,
                  base_score = 0.1)

xgb_test <- predict(bst2, data.matrix(test[,-c(1,21)]))

RMSE_xgboost <- RMSE(test$main, xgb_test)

MAE_xgboost <- MAE(test$main,xgb_test)
```

```
## [1] "RMSE for XGB: 1768431748374.33"
```

```
## [1] "MAE for XGB: 1392695325712"
```

```
head(rmse)
```

```
##              [,1]
## RMSE1        "6478712621862.47"
## RMSE_forest  "3931069158250.22"
## RMSE_lasso   "5628571121840.2"
## RMSE_ridge   "5694886002039.19"
## RMSE_Tree    "1856565948984.63"
## RMSE_xgboost "1768431748374.33"
```

```
## [1] "the Algorithm with the least error is: 1768431748374.33"
```

```r
## Ridge Regression
mean_error(difference(ridge.pred,test$main))
```

```
## [1] 0.5684114
```

```r
## Extreme Gradient Boosting
mean_error(difference(xgb_test,test$main))
```

```
## [1] 0.1015254
```

```r
## Lasso Regression
mean_error(difference(lasso.pred,test$main))
```

```
## [1] 0.5461268
```

```r
##Forest
mean_error(difference(prediction_forest,test$main))
```

```
## [1] 0.2004457
```

```r
# Linear Regression
mean_error(difference(pred1,test$main))
```

```
## [1] 0.8719786
```

```r
## knn
mean_error(difference(model_predict_test,test$main))
```

```
## [1] 0.1051968
```

```r
## Tree
mean_error(difference(model_predict_test,test$main))
```

```
## [1] 0.1051968
```