Trabalho - Econometria IV

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```r
library(lubridate)  # for handling dates
library(randomForest)  # Random Forest implementation of the original Fortran code by Brieman (2001)
library(ranger)  # Faster implementation of Random Forest
```

Question 3

Item D

In order to include the lags of the variables as covariates, we need to do an embedding process. explicar. (We do this inside the rolling window loop to avoid 'cheating').

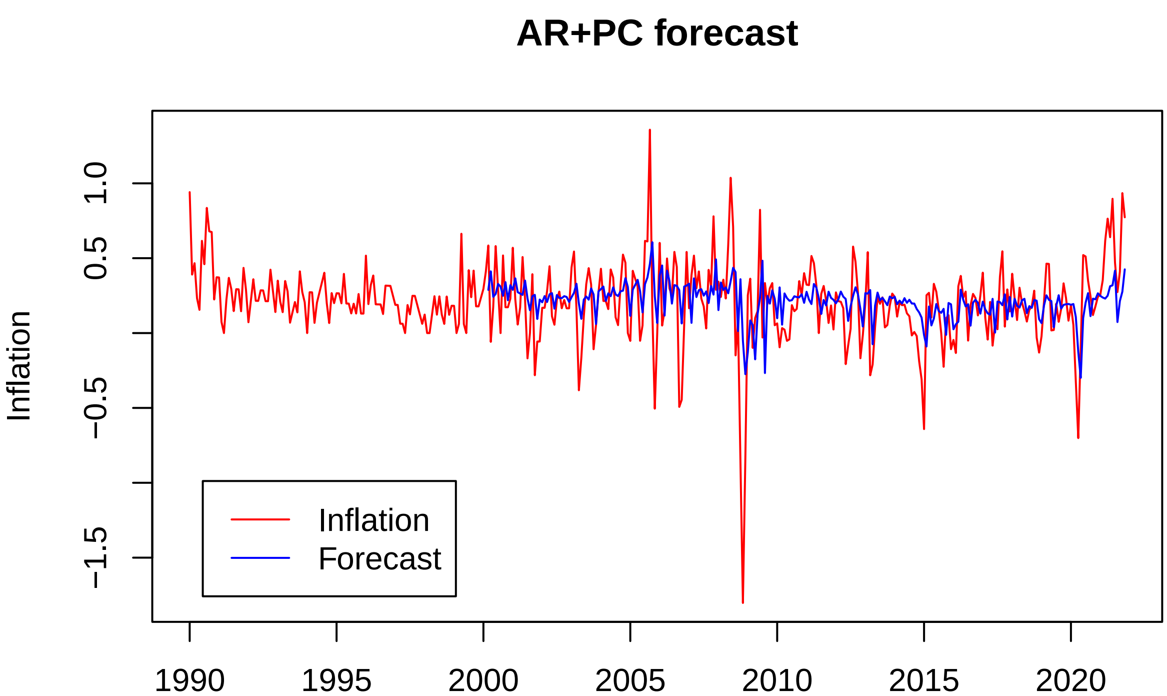
After this process, we can use the usual IID bootstrap, since we are interested in direct forecasting.

```r
# Embedding
n_lags = 4  # number of lags to be embeded
my_embed = function(df) {
    Lags = list()
    Lags[[1]] = df %>%
        select(-date)
    for (i in 1:n_lags) {
        Lags[[i + 1]] = df %>%
            select(-date) %>%
            mutate_all(function(x) lag(x, n = i))
    }
    RF_data = reduce(Lags, function(x, y) {
        bind_cols(x, y, .name_repair = ~make.unique(.x))
    })

    return(RF_data)
}
```

```r
# Rolling window forecasting
rolling_window <- 492

# Random Forest parameters
p = (1+n_lags)*ncol(data) # number of variables
mtry = ((1/3)*p) %>% round() # number of variables randomly selected
num.trees = 500 # number of trees
min.bucket = 5 # minimal number of observations in each leave (terminal node)


set.seed(1430)
```

```r
forecast1 = list()

for(a in 1:(length(inflation)-rolling_window)){
  # get the window for training the model
  train = data[a:(a+rolling_window-1), ]
  # embed
  RF_data = my_embed(train)
  # bind the embeded columns with the one-step-ahead inflation
  RF_data = bind_cols(inflation.ahead = lead(inflation[a:(a+rolling_window-1)]), RF_data)

  # Random forest estimation
  RF = ranger(inflation.ahead ~.,
              data = RF_data %>% na.omit(),
              oob.error = T,
              # Parameters below are set previously
              mtry = mtry,
              num.trees = num.trees,
              min.bucket = min.bucket)

  # Prediction
  new = RF_data %>% select(-inflation.ahead) %>% tail(1)
  forecast1[a] = predict(RF, data = new)
}

forecast1 = forecast1 %>% unlist() %>%
  ts(start = start(inflation)+c(0,rolling_window), frequency =  frequency(inflation) )
```

```r
# print(RF) beepr::beep(8)
```



Item E

```r
# Forecasting error
error = inflation - forecasts
cum_error = error %>%
    data.frame() %>%
    mutate_all(function(x) {
        (x^2) %>%
            cumsum()
    }) %>%
    bind_cols(date = zoo::as.Date.yearmon(time(error))) %>%
    setNames(c("AR", "AR_PC", "RF", "date"))
```