

EPIWEEK ARIMAX MODELS - Influenza hospitalization data

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This function utilizes ensembles and single automatic ARIMAX models which have mean cases by epidemiological weeks over the last 2 years as exogenous variables. The function fits on a rolling window of previous 104 weeks for the state under analysis and a rolling windows with the same size with 1 week-lag for the exogenous variables to generate forecasts. It return some metrics that evaluate the performance of the models: target_end_date, abs_error, cases, forecast, 'N_of_models', weighted interval score (WIS), predictive quantiles. The user can choose a single best automatic ARIMAXs (auto=TRUE), or ensembles of 27 permutations of 0,1,2 pdq's (ES27=TRUE) or 64 permutations of 0,1,2,3 pdq's (ES64=TRUE). The user also chooses the number of weeks ahead for each forecast, and the size of the rolling window which is set as 2 years (104 weeks).

```
knitr::opts_chunk$set(echo = TRUE)
```

!!!!!!!!!!!!!!!!!!!! LOADING THE PACKAGES !!!!!!!!!!!!!!!!!!!!!

```
library("tidyr")
library("MMWRweek")
library("data.table")
library("caret")
```

```
## Loading required package: ggplot2
```

```
## Loading required package: lattice
```

```
library("purrr")
```

```
##
```

```
## Attaching package: 'purrr'
```

```
## The following object is masked from 'package:caret':
```

```
##
```

```
## lift
```

```
## The following object is masked from 'package:data.table':
```

```
##
```

```
## transpose
```

```
library("dplyr")
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:data.table':
##
##   between, first, last

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

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

```
library("tseries")
```

```
## Registered S3 method overwritten by 'quantmod':
##   method      from
##   as.zoo.data.frame zoo
```

```
library("gtools")
library("forecast")
library("scoringutils")
```

```
## Note: scoringutils is currently undergoing major development changes (with an update planned for the
```

```
library("covidHubUtils")
library("parallel")
library("future")#https://cran.r-project.org/web/packages/future/vignettes/future-4-issues.html
```

```
##
## Attaching package: 'future'

## The following object is masked from 'package:tseries':
##
##   value

## The following object is masked from 'package:caret':
##
##   cluster
```

```
library("listenv")
```

```
##
## Attaching package: 'listenv'

## The following object is masked from 'package:purrr':
##
##   map
```

```
library("epitools")
```

!!!!!!!!!!!!!!!!!!!!!!!!!!!! LOADING DATASET AND FUNCTIONS !!!!!!!!!!!!!!!!!!!!!!!!!!!!!

```
#####  
#      LOADING AND CLEANING THE DATASET      #  
#####  
  
# Loads the ADJACENT states models  
source("ES_EPIWEEK.R", local = TRUE, chdir = TRUE)  
  
# Loads the ILI dataset  
my_data = read.csv("treated_influenza_hosp_dataframe_v2.csv")  
my_data$target_end_date<-as.Date(my_data$target_end_date) # set the dates as dates  
  
list_of_states <- split(my_data, my_data$state_name)
```

AUTO EPIWEEK WEEK1

```
start_time <- Sys.time()  
  
# RUN MODEL  
AUTO_EPIWEEK_WEEK1_list <- mclapply(list_of_states, ES_EPIWEEK, auto=TRUE, n_weeks_ahead=1, week_lag=1, n  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

Time difference of 10.16884 mins

```
# FINAL DATAFRAME  
AUTO_EPIWEEK_WEEK1 <- bind_rows(AUTO_EPIWEEK_WEEK1_list, .id = "State")  
  
# SAVE TO CORRECT FOLDER  
#write.csv(EPIWEEK/AUTO/AUTO_EPIWEEK_WEEK1, file = "AUTO_EPIWEEK_WEEK1.csv", row.names = TRUE)
```

AUTO EPIWEEK WEEK2

```
start_time <- Sys.time()  
  
# RUN MODEL  
AUTO_EPIWEEK_WEEK2_list <- mclapply(list_of_states, ES_EPIWEEK, auto=TRUE, n_weeks_ahead=2, week_lag=1, n  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

Time difference of 10.02198 mins

```
# FINAL DATAFRAME
```

```
AUTO_EPIWEEK_WEEK2 <- bind_rows(AUTO_EPIWEEK_WEEK2_list, .id = "State")
```

AUTO EPIWEEK WEEK3

```
start_time <- Sys.time()
```

```
AUTO_EPIWEEK_WEEK3_list <- mclapply(list_of_states, ES_EPIWEEK, auto=TRUE, n_weeks_ahead=3, week_lag=1, ,  
  setNames(names(list_of_states)))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 9.781443 mins
```

```
# Combine the list of data frames into a single data frame with names as a column
```

```
AUTO_EPIWEEK_WEEK3 <- bind_rows(AUTO_EPIWEEK_WEEK3_list, .id = "State")
```

AUTO EPIWEEK WEEK4

```
start_time <- Sys.time()
```

```
AUTO_EPIWEEK_WEEK4_list <- mclapply(list_of_states, ES_EPIWEEK, auto=TRUE, n_weeks_ahead=4, week_lag=1, ,  
  setNames(names(list_of_states)))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 9.869524 mins
```

```
# Combine the list of data frames into a single data frame with names as a column
```

```
AUTO_EPIWEEK_WEEK4 <- bind_rows(AUTO_EPIWEEK_WEEK4_list, .id = "State")
```

```
save.image("EPIWEEK_MODELS_influenza_hospitalization.Rdata")
```

ES27 EPIWEEK WEEK1

```
start_time <- Sys.time()
```

```
ES27_EPIWEEK_WEEK1_list <- mclapply(list_of_states, ES_EPIWEEK, ES27=TRUE, n_weeks_ahead=1, week_lag=1, ,  
  setNames(names(list_of_states)))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 16.6139 mins
```

```
# Combine the list of data frames into a single data frame with names as a column  
ES27_EPIWEEK_WEEK1 <- bind_rows(ES27_EPIWEEK_WEEK1_list, .id = "State")
```

ES27 EPIWEEK WEEK2

```
start_time <- Sys.time()
```

```
ES27_EPIWEEK_WEEK2_list <- mclapply(list_of_states, ES_EPIWEEK, ES27=TRUE, n_weeks_ahead=2, week_lag=1, n  
  setNames(names(list_of_states))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 16.56291 mins
```

```
# Combine the list of data frames into a single data frame with names as a column  
ES27_EPIWEEK_WEEK2 <- bind_rows(ES27_EPIWEEK_WEEK2_list, .id = "State")
```

ES27 EPIWEEK WEEK3

```
start_time <- Sys.time()
```

```
ES27_EPIWEEK_WEEK3_list <- mclapply(list_of_states, ES_EPIWEEK, ES27=TRUE, n_weeks_ahead=3, week_lag=1, n  
  setNames(names(list_of_states))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 17.08834 mins
```

```
# Combine the list of data frames into a single data frame with names as a column  
ES27_EPIWEEK_WEEK3 <- bind_rows(ES27_EPIWEEK_WEEK3_list, .id = "State")
```

ES27 EPIWEEK WEEK4

```
start_time <- Sys.time()
```

```
ES27_EPIWEEK_WEEK4_list <- mclapply(list_of_states, ES_EPIWEEK, ES27=TRUE, n_weeks_ahead=4, week_lag=1, n  
  setNames(names(list_of_states))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 16.56015 mins
```

```
# Combine the list of data frames into a single data frame with names as a column
ES27_EPIWEEK_WEEK4 <- bind_rows(ES27_EPIWEEK_WEEK4_list, .id = "State")
```

```
save.image("EPIWEEK_MODELS_influenza_hospitalization.Rdata")
```

ES64 EPIWEEK WEEK1

```
start_time <- Sys.time()
```

```
ES64_EPIWEEK_WEEK1_list <- mclapply(list_of_states, ES_EPIWEEK, ES64=TRUE, n_weeks_ahead=1, week_lag=1, n
  setNames(names(list_of_states))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 47.71215 mins
```

```
# Combine the list of data frames into a single data frame with names as a column
ES64_EPIWEEK_WEEK1 <- bind_rows(ES64_EPIWEEK_WEEK1_list, .id = "State")
```

ES64 EPIWEEK WEEK2

```
start_time <- Sys.time()
```

```
ES64_EPIWEEK_WEEK2_list <- mclapply(list_of_states, ES_EPIWEEK, ES64=TRUE, n_weeks_ahead=2, week_lag=1, n
  setNames(names(list_of_states))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 46.6614 mins
```

```
# Combine the list of data frames into a single data frame with names as a column
ES64_EPIWEEK_WEEK2 <- bind_rows(ES64_EPIWEEK_WEEK2_list, .id = "State")
```

ES64 EPIWEEK WEEK3

```
start_time <- Sys.time()
```

```
ES64_EPIWEEK_WEEK3_list <- mclapply(list_of_states, ES_EPIWEEK, ES64=TRUE, n_weeks_ahead=3, week_lag=1, n
  setNames(names(list_of_states))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 45.2946 mins
```

```
# Combine the list of data frames into a single data frame with names as a column  
ES64_EPIWEEK_WEEK3 <- bind_rows(ES64_EPIWEEK_WEEK3_list, .id = "State")
```

```
ES64 EPIWEEK WEEK4
```

```
start_time <- Sys.time()
```

```
ES64_EPIWEEK_WEEK4_list <- mclapply(list_of_states, ES_EPIWEEK, ES64=TRUE, n_weeks_ahead=4, week_lag=1, m  
  setNames(names(list_of_states))
```

```
end_time <- Sys.time()
```

```
run_time <- end_time - start_time
```

```
print(run_time)
```

```
## Time difference of 41.46782 mins
```

```
# Combine the list of data frames into a single data frame with names as a column  
ES64_EPIWEEK_WEEK4 <- bind_rows(ES64_EPIWEEK_WEEK4_list, .id = "State")
```

```
save.image("EPIWEEK_MODELS_influenza_hospitalization.Rdata")
```