

# EPIWEEK ARIMAX MODELS - with log-back transformations - (correct exp)

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Here we run ensembles and single automatic ARIMAX models for forecasting weekly hospitalizations in 48 states on the contiguous U.S. These model use mean hospitalizations 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. These models include log-back transformations. 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,
  setNames(names(list_of_states))

end_time <- Sys.time()
run_time <- end_time - start_time

print(run_time)
```

## Time difference of 9.271892 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,
  setNames(names(list_of_states))

end_time <- Sys.time()
run_time <- end_time - start_time

print(run_time)
```

```
## Time difference of 9.164596 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, n  
  setNames(names(list_of_states))
```

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

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

```
print(run_time)
```

```
## Time difference of 8.952546 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, n  
  setNames(names(list_of_states))
```

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

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

```
print(run_time)
```

```
## Time difference of 9.013394 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, n  
  setNames(names(list_of_states))
```

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

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

```
print(run_time)
```

```
## Time difference of 14.84211 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 15.00513 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 14.92407 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 14.85922 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 42.21283 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 42.33601 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 42.45622 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 40.82601 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")
```