

# AVERAGE STATES ARIMAX MODEL - without log-back transformations

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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 hospitalization across the U.S. states 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 do not 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 DATASET !!!!!!!
```

```
library("tidyverse")
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 AVERAGE states models  
source("ES_AVERAGE_48_nolog.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 AVERAGE WEEK1 - ALL STATES

```
start_time <- Sys.time()  
  
AUTO_AVERAGE_WEEK1_list <- mclapply(list_of_states, ES_AVERAGE, auto=TRUE, n_weeks_ahead=1, list_of_state  
    setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)  
  
## Time difference of 12.64375 mins  
  
# FINAL DATAFRAME  
AUTO_AVERAGE_WEEK1 <- bind_rows(AUTO_AVERAGE_WEEK1_list, .id = "State")
```

AUTO AVERAGE WEEK2 - ALL STATES

```
start_time <- Sys.time()  
  
# RUN MODEL  
AUTO_AVERAGE_WEEK2_list <- mclapply(list_of_states, ES_AVERAGE, auto=TRUE, n_weeks_ahead=2, list_of_state  
    setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)  
  
## Time difference of 12.16792 mins
```

```
# FINAL DATAFRAME
AUTO_AVERAGE_WEEK2 <- bind_rows(AUTO_AVERAGE_WEEK2_list, .id = "State")
```

AUTO AVERAGE WEEK3 - ALL STATES

```
start_time <- Sys.time()

AUTO_AVERAGE_WEEK3_list <- mclapply(list_of_states, ES_AVERAGE, auto=TRUE, n_weeks_ahead=3, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)

## Time difference of 11.84344 mins

# Combine the list of data frames into a single data frame with names as a column
AUTO_AVERAGE_WEEK3 <- bind_rows(AUTO_AVERAGE_WEEK3_list, .id = "State")
```

AUTO AVERAGE WEEK4 - ALL STATES

```
start_time <- Sys.time()

AUTO_AVERAGE_WEEK4_list <- mclapply(list_of_states, ES_AVERAGE, auto=TRUE, n_weeks_ahead=4, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)

## Time difference of 11.95872 mins

# Combine the list of data frames into a single data frame with names as a column
AUTO_AVERAGE_WEEK4 <- bind_rows(AUTO_AVERAGE_WEEK4_list, .id = "State")

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

ES27 AVERAGE WEEK1 - ALL STATES

```
start_time <- Sys.time()

ES27_AVERAGE_WEEK1_list <- mclapply(list_of_states, ES_AVERAGE, ES27=TRUE, n_weeks_ahead=1, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

```
## Time difference of 18.13208 mins

# FINAL DATAFRAME
ES27_AVERAGE_WEEK1 <- bind_rows(ES27_AVERAGE_WEEK1_list, .id = "State")
```

ES27 AVERAGE WEEK2 - ALL STATES

```
start_time <- Sys.time()

ES27_AVERAGE_WEEK2_list <- mclapply(list_of_states, ES_AVERAGE, ES27=TRUE, n_weeks_ahead=2, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

## Time difference of 18.21007 mins

```
# FINAL DATAFRAME
ES27_AVERAGE_WEEK2 <- bind_rows(ES27_AVERAGE_WEEK2_list, .id = "State")
```

ES27 AVERAGE WEEK3 - ALL STATES

```
start_time <- Sys.time()

ES27_AVERAGE_WEEK3_list <- mclapply(list_of_states, ES_AVERAGE, ES27=TRUE, n_weeks_ahead=3, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

## Time difference of 17.96132 mins

```
# FINAL DATAFRAME
ES27_AVERAGE_WEEK3 <- bind_rows(ES27_AVERAGE_WEEK3_list, .id = "State")
```

ES27 AVERAGE WEEK4 - ALL STATES

```
start_time <- Sys.time()

ES27_AVERAGE_WEEK4_list <- mclapply(list_of_states, ES_AVERAGE, ES27=TRUE, n_weeks_ahead=4, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

## Time difference of 18.13278 mins

```
# FINAL DATAFRAME
ES27_AVERAGE_WEEK4 <- bind_rows(ES27_AVERAGE_WEEK4_list, .id = "State")

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

ES64 AVERAGE WEEK1 - ALL STATES

```
start_time <- Sys.time()

ES64_AVERAGE_WEEK1_list <- mclapply(list_of_states, ES_AVERAGE, ES64=TRUE, n_weeks_ahead=1, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

## Time difference of 51.79764 mins

```
# FINAL DATAFRAME
ES64_AVERAGE_WEEK1 <- bind_rows(ES64_AVERAGE_WEEK1_list, .id = "State")
```

ES64 AVERAGE WEEK2 - ALL STATES

```
start_time <- Sys.time()

ES64_AVERAGE_WEEK2_list <- mclapply(list_of_states, ES_AVERAGE, ES64=TRUE, n_weeks_ahead=2, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

## Time difference of 51.5365 mins

```
# Combine the list of data frames into a single data frame with names as a column
ES64_AVERAGE_WEEK2 <- bind_rows(ES64_AVERAGE_WEEK2_list, .id = "State")
```

ES64 AVERAGE WEEK3 - ALL STATES

```
start_time <- Sys.time()

ES64_AVERAGE_WEEK3_list <- mclapply(list_of_states, ES_AVERAGE, ES64=TRUE, n_weeks_ahead=3, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

```
## Time difference of 47.73165 mins

# Combine the list of data frames into a single data frame with names as a column
ES64_AVERAGE_WEEK3 <- bind_rows(ES64_AVERAGE_WEEK3_list, .id = "State")
```

ES64 AVERAGE WEEK4 - ALL STATES

```
start_time <- Sys.time()

ES64_AVERAGE_WEEK4_list <- mclapply(list_of_states, ES_AVERAGE, ES64=TRUE, n_weeks_ahead=4, list_of_states)
  setNames(names(list_of_states))

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

print(run_time)
```

## Time difference of 42.22225 mins

```
# Combine the list of data frames into a single data frame with names as a column
ES64_AVERAGE_WEEK4 <- bind_rows(ES64_AVERAGE_WEEK4_list, .id = "State")
```

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