

# ARIMA MODELS - with log-back transformations (correct exp)

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Here we run ensembles and single automatic ARIMA models for forecasting weekly hospitalizations in 48 states on the contiguous U.S. The models fit on a rolling window of previous 104 weeks to generate forecasts. These models include log-back transformations. It returns some metrics that evaluate the performance of the models: target\_end\_date, abs\_error, cases, forecast, number of models, weighted interval score (WIS) and predictive quantiles (%). The user defines if it will use an AUTO ARIMA (auto=TRUE), or ensembles of 27 (ES27=TRUE) or ensembles of 64 models (ES64=TRUE). It can also choose the number of weeks ahead for each forecast, and the size of the rolling window which is set as 104 (2 years).

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

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

```
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("epitoools")
```

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

```
#####
#      LOADING AND CLEANING THE DATASET #
#####

# Loads the ADJACENT states models
source("ES_ARIMA.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 ARIMA WEEK1

```
start_time <- Sys.time()

AUTO_ARIMA_WEEK1_list <- mclapply(list_of_states, ES_ARIMA, auto=TRUE, n_weeks_ahead=1, mc.cores=2)%>%
  setNames(names(list_of_states))

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

print(run_time)

## Time difference of 7.374614 mins

# Combine the list of data frames into a single data frame with names as a column
AUTO_ARIMA_WEEK1 <- bind_rows(AUTO_ARIMA_WEEK1_list, .id = "State")
```

AUTO ARIMA WEEK2

```
start_time <- Sys.time()

AUTO_ARIMA_WEEK2_list <- mclapply(list_of_states , ES_ARIMA, auto=TRUE, n_weeks_ahead=2, mc.cores=2)%>%
  setNames(names(list_of_states))

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

print(run_time)

## Time difference of 7.246378 mins

# Combine the list of data frames into a single data frame with names as a column
AUTO_ARIMA_WEEK2 <- bind_rows(AUTO_ARIMA_WEEK2_list, .id = "State")
```

## AUTO ARIMA WEEK3

```
start_time <- Sys.time()

AUTO_ARIMA_WEEK3_list <- mclapply(list_of_states , ES_ARIMA, auto=TRUE, n_weeks_ahead=3, mc.cores=2)%>%
  setNames(names(list_of_states))

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

print(run_time)

## Time difference of 7.075681 mins

# Combine the list of data frames into a single data frame with names as a column
AUTO_ARIMA_WEEK3 <- bind_rows(AUTO_ARIMA_WEEK3_list, .id = "State")
```

## AUTO ARIMA WEEK4

```
start_time <- Sys.time()

AUTO_ARIMA_WEEK4_list <- mclapply(list_of_states, ES_ARIMA, auto=TRUE, n_weeks_ahead=4 ,mc.cores=2)%>%
  setNames(names(list_of_states))

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

print(run_time)

## Time difference of 7.070171 mins

# Combine the list of data frames into a single data frame with names as a column
AUTO_ARIMA_WEEK4 <- bind_rows(AUTO_ARIMA_WEEK4_list, .id = "State")

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

## ES27 ARIMA WEEK1

```
start_time <- Sys.time()

ES27_ARIMA_WEEK1_list <- mclapply(list_of_states, ES_ARIMA, ES27=TRUE, n_weeks_ahead=1, mc.cores=2)%>%
  setNames(names(list_of_states))

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

print(run_time)

## Time difference of 10.74457 mins
```

```
# Combine the list of data frames into a single data frame with names as a column  
ES27_ARIMA_WEEK1 <- bind_rows(ES27_ARIMA_WEEK1_list, .id = "State")
```

ES27 ARIMA WEEK2

```
start_time <- Sys.time()  
  
ES27_ARIMA_WEEK2_list <- mclapply(list_of_states, ES_ARIMA, ES27=TRUE, n_weeks_ahead=2, mc.cores=2)%>%  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

## Time difference of 10.80277 mins

```
# Combine the list of data frames into a single data frame with names as a column  
ES27_ARIMA_WEEK2 <- bind_rows(ES27_ARIMA_WEEK2_list, .id = "State")
```

ES27 ARIMA WEEK3

```
start_time <- Sys.time()  
  
ES27_ARIMA_WEEK3_list <- mclapply(list_of_states, ES_ARIMA, ES27=TRUE, n_weeks_ahead=3, mc.cores=2)%>%  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

## Time difference of 10.83073 mins

```
# Combine the list of data frames into a single data frame with names as a column  
ES27_ARIMA_WEEK3 <- bind_rows(ES27_ARIMA_WEEK3_list, .id = "State")
```

ES27 ARIMA WEEK4

```
start_time <- Sys.time()  
  
ES27_ARIMA_WEEK4_list <- mclapply(list_of_states, ES_ARIMA, ES27=TRUE, n_weeks_ahead=4 ,mc.cores=2)%>%  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

## Time difference of 11.10238 mins

```
# Combine the list of data frames into a single data frame with names as a column  
ES27_ARIMA_WEEK4 <- bind_rows(ES27_ARIMA_WEEK4_list, .id = "State")
```

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

ES64 ARIMA WEEK1

```
start_time <- Sys.time()  
  
ES64_ARIMA_WEEK1_list <- mclapply(list_of_states, ES_ARIMA, ES64=TRUE, n_weeks_ahead=1, mc.cores=2)%>%  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

## Time difference of 28.93961 mins

```
# Combine the list of data frames into a single data frame with names as a column  
ES64_ARIMA_WEEK1 <- bind_rows(ES64_ARIMA_WEEK1_list, .id = "State")
```

ES64 ARIMA WEEK2

```
start_time <- Sys.time()  
  
ES64_ARIMA_WEEK2_list <- mclapply(list_of_states, ES_ARIMA, ES64=TRUE, n_weeks_ahead=2, mc.cores=2)%>%  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

## Time difference of 29.46006 mins

```
# Combine the list of data frames into a single data frame with names as a column  
ES64_ARIMA_WEEK2 <- bind_rows(ES64_ARIMA_WEEK2_list, .id = "State")
```

ES64 ARIMA WEEK3

```
start_time <- Sys.time()  
  
ES64_ARIMA_WEEK3_list <- mclapply(list_of_states, ES_ARIMA, ES64=TRUE, n_weeks_ahead=3, mc.cores=2)%>%  
  setNames(names(list_of_states))  
  
end_time <- Sys.time()  
run_time <- end_time - start_time  
  
print(run_time)
```

```
## Time difference of 29.93642 mins

# Combine the list of data frames into a single data frame with names as a column
ES64_ARIMA_WEEK3 <- bind_rows(ES64_ARIMA_WEEK3_list, .id = "State")
```

ES64 ARIMA WEEK4

```
start_time <- Sys.time()

ES64_ARIMA_WEEK4_list <- mclapply(list_of_states, ES_ARIMA, ES64=TRUE, n_weeks_ahead=4 ,mc.cores=2)%>%
  setNames(names(list_of_states))

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

print(run_time)
```

## Time difference of 29.04284 mins

```
# Combine the list of data frames into a single data frame with names as a column
ES64_ARIMA_WEEK4 <- bind_rows(ES64_ARIMA_WEEK4_list, .id = "State")
```

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