ISA 444: Business Forecasting

21: Seasonal ARIMA Models

Fadel M. Megahed, PhD

Endres Associate Professor
Farmer School of Business
Miami University

@FadelMegahed
fmegahed
fmegahed@miamioh.edu
Automated Scheduler for Office Hours

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Quick Refresher from Last Class

✅ Explain how ARIMA models work when compared to ARMA models.

✅ Fit an ARIMA model to a time series, evaluate the residuals of a fitted ARMA model to assess goodness of fit, use the Ljung-Box test for correlation among the residuals of an ARIMA model.

✅ Describe AIC, AICc, and BIC and how they are used to measure model fit.

✅ Describe the algorithm used within the `auto.arima()` function to fit an ARIMA model.

✅ Describe the results of the `auto.arima()` function.

Quick Refresher from the Lab

We will copy the code below and go through it line by line in class.

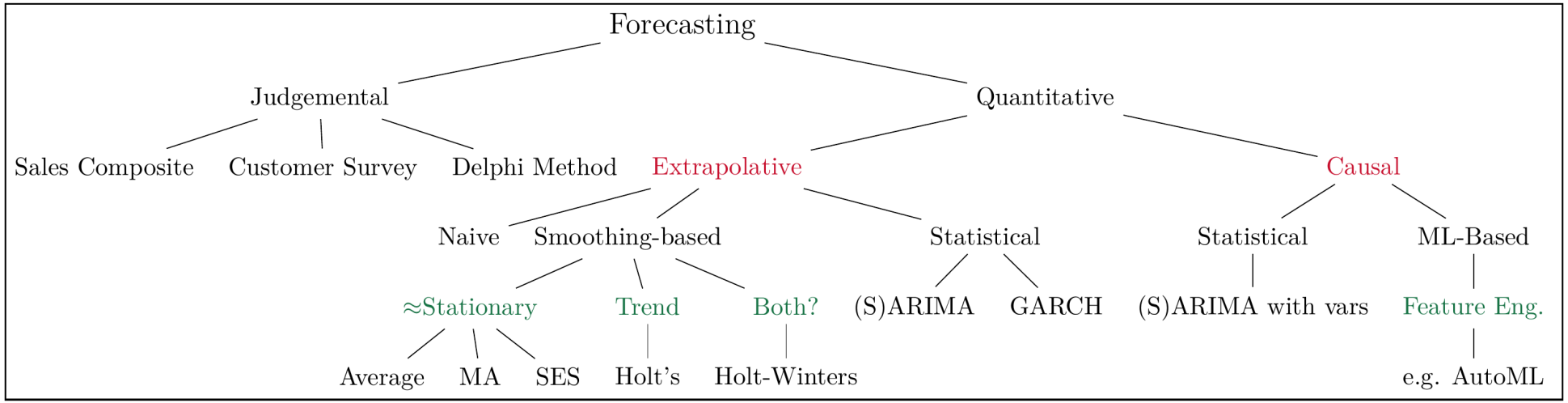
```
macros = tidyquant::tq_get(
  x = c('GNP', 'TOTALSA'),
  get = 'economic.data',
  from = '1947-01-01'
)

# to nest a dataset by symbol we need to first group the data
macros_nested = macros |> dplyr::group_by(symbol) |> tidyr::nest()

macros_nested_rolled =
  macros_nested |>
  # automatically obtaining the initial length of each training set and then rolling it
  dplyr::mutate(
    initial_length = (purrr::map_dbl(.x = data, .f = nrow) * 0.95) |>  ceiling(),
    rolled = purrr::map2(
      .x = data, .y = initial_length,  .f = rsample::rolling_origin,
      assess = 1, cumulative = TRUE
      ) ) |> # unnest rolled so that the length equals splits * symbols
  tidyr::unnest(rolled)

macros_nested_rolled =
  macros_nested_rolled |>
```

Overview of Univariate Forecasting Methods



A 10,000 foot view of forecasting techniques

Notes: My (incomplete) classification of **univariate** forecasting techniques, i.e., they exclude popular approaches used in multivariate time series forecasting.

Learning Objectives for Today's Class

- Recognize when to fit a seasonal ARIMA model.
- Describe a seasonal ARIMA model and explain how it applies to a seasonal time series.

Seasonal ARIMA Models

When to Fit a Seasonal ARIMA?

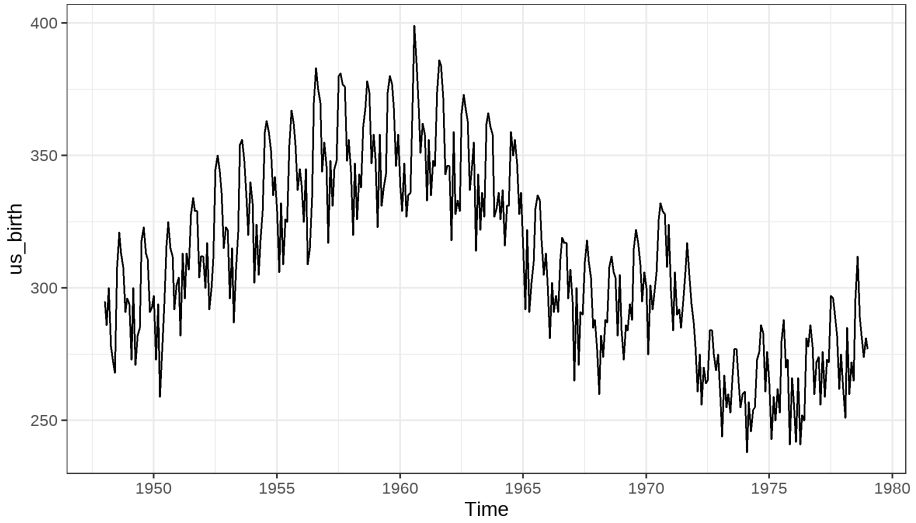
Step 1: Plot the Time Series

For example,

```
if(require(astsa)==F) install.packages('astsa')

# today's data: monthly us birth (Jan 48 - Jan 79)
us_birth = astsa::birth

forecast::autoplot(us_birth) + ggplot2::theme_bw()
```



When to Fit a Seasonal ARIMA?

Step 2: Difference if Needed

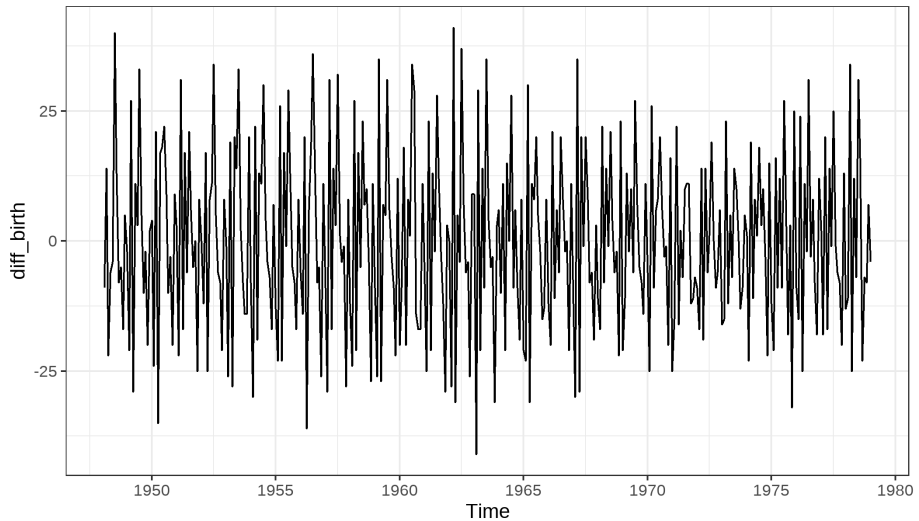
For example,

```
# check for stationary ts
forecast::ndiffs(us_birth)

# diff (if needed)
# using base diff since the input is a time series
# set differences to the differences needed
diff_birth = diff(us_birth, differences = 1)

forecast::autoplot(diff_birth) +
  ggplot2::theme_bw()
```

```
## [1] 1
```



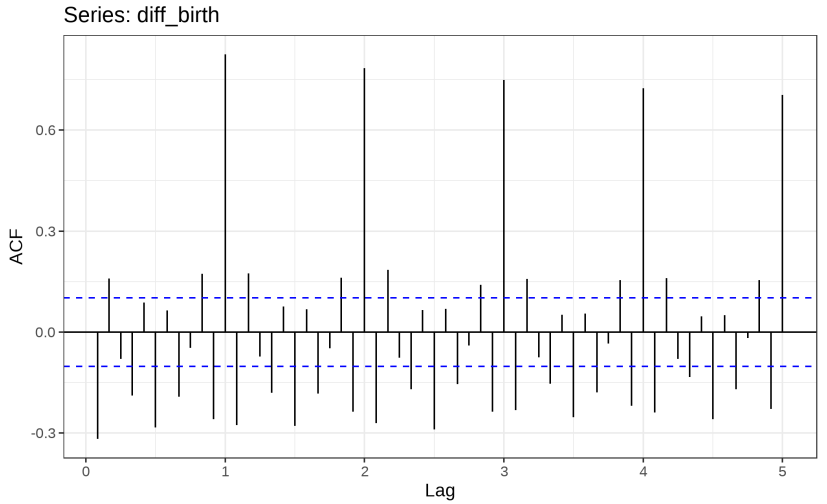
When to Fit a Seasonal ARIMA?

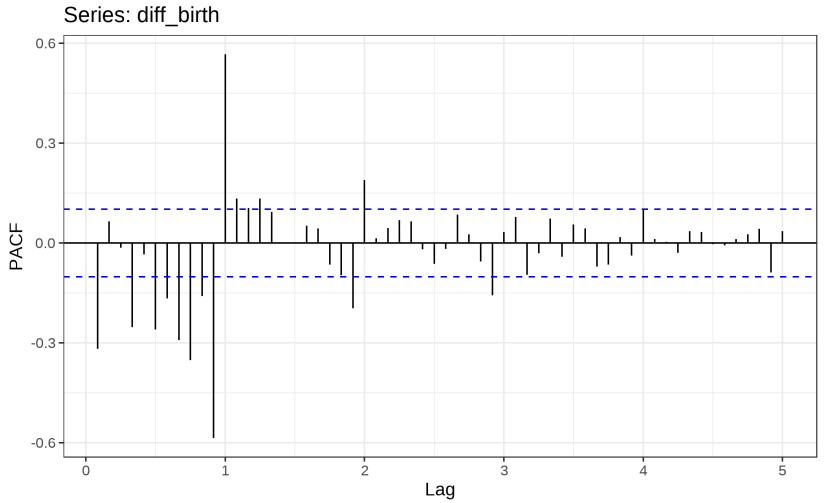
Step 3: ACF and PACF on (differenced) ts

For example,

```
acf(diff_birth, plot = F, lag.max = 60) |>
  forecast::autoplot() + ggplot2::theme_bw() +
  # specifying the number of labels for x-axis
  ggplot2::scale_x_continuous(
    breaks = scales::pretty_breaks(6)
    )

pacf(diff_birth, plot = F,  lag.max = 60) |>
  forecast::autoplot() + ggplot2::theme_bw() +
  # specifying the number of labels for x-axis
  ggplot2::scale_x_continuous(
    breaks = scales::pretty_breaks(6)
    )
```





How to Fit a Seasonal ARIMA?

Let us continue with the `birth` dataset from the astsa package for a live coding example.

In-Class Activity

Use the data “netflix_growth_pct_2000.csv”.

- Fit an ARIMA model using the `forecast::auto.arima()` function.
- Describe the model that is fit.
- Evaluate the model residuals.

Recap

Summary of Main Points

By now, you should be able to do the following:

- Recognize when to fit a seasonal ARIMA model.
- Describe a seasonal ARIMA model and explain how it applies to a seasonal time series.

Things to Do to Prepare for Next Class

- Go through the slides, examples and make sure you have a good understanding of what we have covered.
- Read Chapters 9.9 in Forecasting: Principles and Practice.