

# ISA 444: Business Forecasting

## 22 - Seasonal ARIMA Models

Fadel M. Megahed

Associate Professor  
Department of Information Systems and Analytics  
Farmer School of Business  
Miami University  
Email: [fmegahed@miamioh.edu](mailto:fmegahed@miamioh.edu)  
Office Hours: [Click here to schedule an appointment](#)

Fall 2020

# Outline

1 Preface

2 The `auto.arima()` Function

# Recap of What we Have Covered Last Class

## Main Learning Outcomes

- 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.

# Learning Outcomes for Today's Class

## Main Learning Outcomes

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

# Outline

1 Preface

**2 The `auto.arima()` Function**

## The `auto.arima()` Function [1]

The `auto.arima()` function can be used to automatically fit ARIMA models to a time series. It is a useful function, but it should be used with caution.

### The function

- Uses “brute force” to fit many models and then selects the “best” based on a certain model criterion
- Works best when the data are stationary, but can be used with nonstationary data
- Tends to overfit the data
- Should always be used as a starting point for selecting a model and all models derived from the `auto.arima()` function should be properly vetted and evaluated.

The `auto.arima()` function combines

- Unit root tests (KPSS by default)
- Minimization of AICc to obtain an  $ARIMA(p, d, q)$  model using the following algorithm:

## The `auto.arima()` Function [2]

- ❶ Determine the number of differences,  $d$ , using a sequence of KPSS tests.
- ❷ Determine  $p$  and  $q$  by minimizing AICc after differencing the data  $d$  times. Rather than considering all possible  $p$  and  $q$  combinations, a stepwise approach is taken.
  - The best initial model with lowest AICc is selected from the following four:
    - ARIMA  $(2,d,2)$ ,
    - ARIMA  $(0,d,0)$ ,
    - ARIMA  $(1,d,0)$ , and
    - ARIMA  $(1,d,0)$ .*If  $d=0$ , then a constant,  $c$ , is included. If  $d \geq 1$ , then the constant is set to 0. The results of this step is called the current model.*
  - Variations on the current model are considered by
    - Vary  $p$  and/or  $q$  from current model by  $\pm 1$
    - Include/exclude  $c$  from current model.

## The `auto.arima()` Function [3]

- The best model considered so far (either current or one of variations) becomes the *new current model*.
- Repeat previous step until no lower AICc can be found.



# Live Coding: Example 1

```
pacman::p_load(astsa)
birthData = birth # also from the astsa package
```

## In-Class Activity

Use the data “22 - Netflix\_growth\_pct\_2000.csv”. Fit an ARIMA model using the `auto.arima()` function. Describe the model that is fit, evaluate the model residuals.

# Things to Do to Prepare for Exam

- Thoroughly read Chapters 6.2-6.8 of our textbook.
- Go through the slides, examples and make sure you have a good understanding of what we have covered.
- Go through the self-paced study guide, which will be shared with you by close of business Thursday.
- Exam will be released by 10 am on Sunday; no class on Monday. You will have until Wednesday 2:50 pm to complete it (once you start the exam, you have three hours to complete it).

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