Timeseries II

// FLATIRON SCHOOL

Learning Goals

By the end of the lecture you should be able to:

Understand Autocorrelation
Understand Partial Autocorrelation

Interpret timeseries
Interpret Autocorrelation plots
Interpret Partial Autocorrelation plots

Use ACF and PACF and the timeseries plot to select optimal parameter values

Understand how timeseries models work

Fit ARMA models
Fit ARIMA models
Fit SARIMA models
Fit SARIMAX models

Generate forecasts from timeseries models
Generate Confidence Intervals for forecasts
Validate a timeseries model

Concept Review

Explain to your partner

What is stationarity?

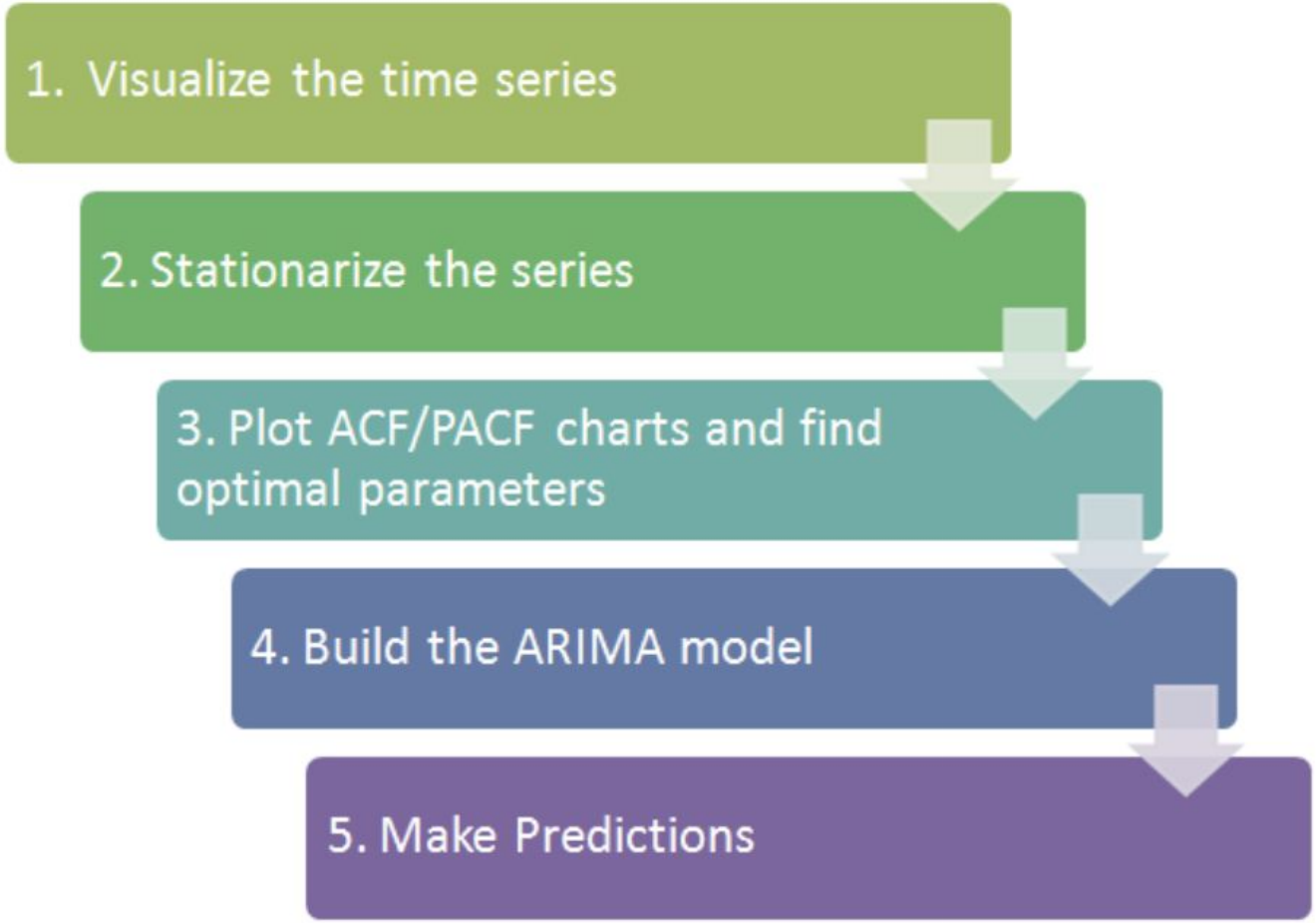
How do you check for stationarity?

How do you interpret the output of the Dickey-Fuller test?

How do you make your data stationary?

What does ‘validation’ mean at a high level/abstract level?

Steps to modeling time series data



Autocorrelation

Autocorrelation

Correlation of the lag of our timeseries with the original

The lag acts as a predictor of the current value

DEMO

NOW IT’S YOUR TIME

Are you ready?!

Partial Autocorrelation

Partial Autocorrelation

Correlation of the lags of our timeseries with the original values AFTER we have controlled for the autocorrelation of previous lags

Moving Average have strong connection with this values

DEMO

NOW IT’S YOUR TIME

Are you ready?!

ARMA

AutoRegressive

Moving Average

Models

The Differencing Rules

Logic

Orders of diff meaning for the original timeseries:

0 = stationary
1 = constant average trend
2 = time-varying trend

Visual process

ACF Shows:

- Sequence of + → Add diff
- All small w/o pattern → Leave it
- Lag-1 <= 0 → Leave it
- Lag-1 <=-.5 → Reduce diff

BEWARE OF OVERDIFFERENCING

Quantitative process

Select the degree of diff that leads to the lowest std

Although, AR or MA terms can help with small differencing issues too

DEMO

NOW IT’S YOUR TIME

Are you ready?!

ARMA

AutoRegressive

Moving Average

Models

The ARMA Rules

PACF of diffed series:
- sharp cutoff / lag-1 >0 → Add AR
-- Optimal AR = term after sharp cutoff

ACF of diffed series:
- sharp cutoff / lag-1 >0 → Add MA
-- Optimal MA = term after sharp cutoff

AR could cancel MA
Try making it work with less terms

If long term forecast erratic or unstable:
- Try trading off AR for diff
- Try decreasing both AR and MA

BEWARE OF MULTIPLE AR & MA TERMS IN THE SAME MODEL

DEMO

NOW IT’S YOUR TIME

Are you ready?!

The Seasonality Rules

If seasonal pattern → Seasonal diff = 1
Note: Regular diff + Seasonal diff <= 2

ACF off diffed series at S:

- Possitive → Add seasonal AR
- Negative → Add seasonal MA

Note: Seasonal AR + Seasonal MA <=2

DEMO

NOW IT’S YOUR TIME

Are you ready?!

The autocorrelation spectrum