



Masterclass

Time series forecasting

2021

Learning objectives

- Introduction to Time series forecasting
- Key concepts of time series forecasting
 - Stationarity, decomposing series
- Build Time series forecasting models using ARIMA, SARIMA, ARIMAX and SARIMAX



8 mins

01

Introduction to time series forecasting

Introduction to Time series

Time series is anything observed sequentially over time

- Most commonly, time series data is observed at equally spaced successive intervals of time
- The measurements taken during an event in a time series are arranged in a proper chronological order

Time series use cases

- Predicting daily stock prices
- Sales forecasting or demand forecasting of products for inventory planning
- Predicting energy demand for future
- Predicting footfall(visitors) for retail stores at different times of day
- Traffic forecasting - transport and route optimization, road facility design
- Weather Forecasting across seasons

Introduction to Time series

How is time series forecasting different from machine learning predictions?

Time is an important factor

A machine learning dataset is a collection of observations. Time does not play the primary role in machine learning datasets. Time Series Models try to understand changes/patterns in data (variable of interest) in response to time

Feature creation

Most of the time series forecasting techniques are univariate, i.e., there is only one feature. So, feature creation does not play a major role. However, certain specific techniques like ARIMAX do use additional features.

15 mins

02

Quiz time!

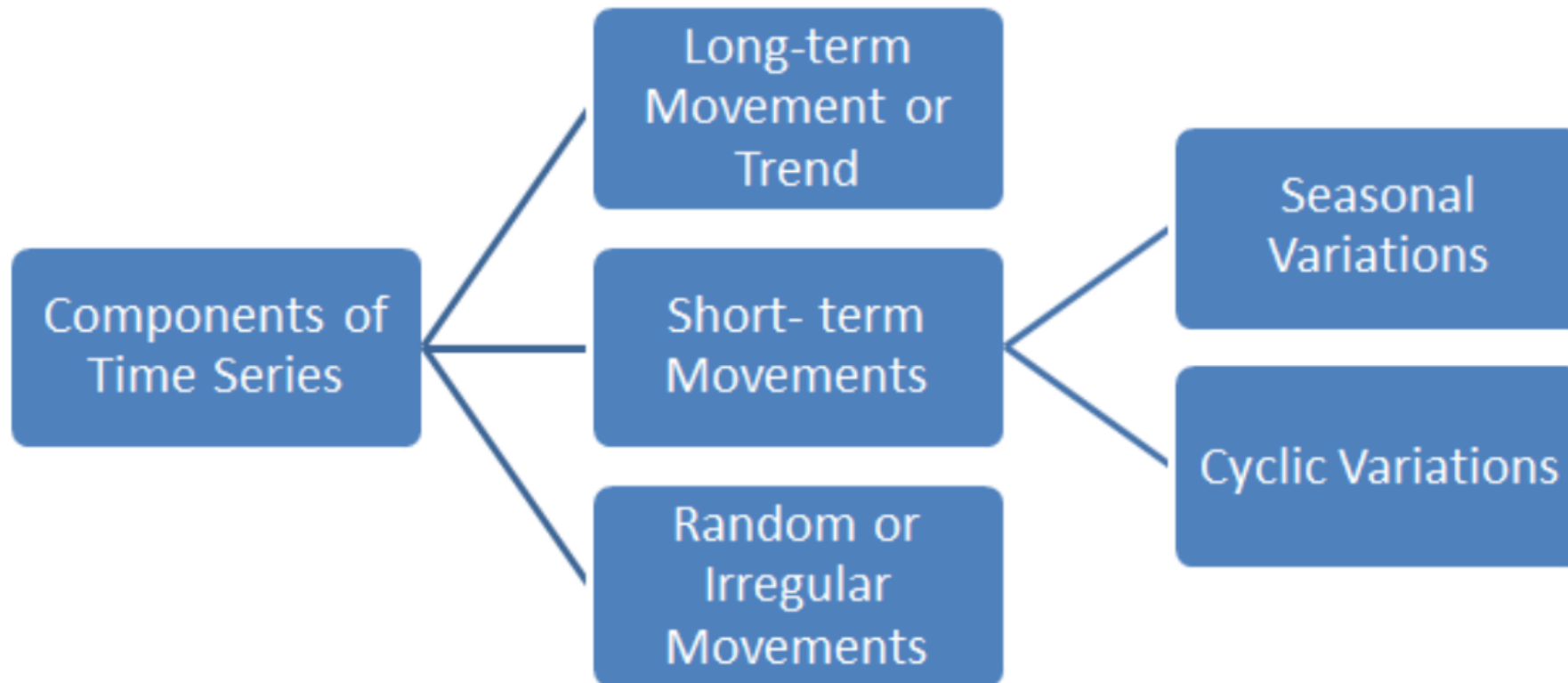
Quiz time!

Predict sales of Oct 2021 based on previous records

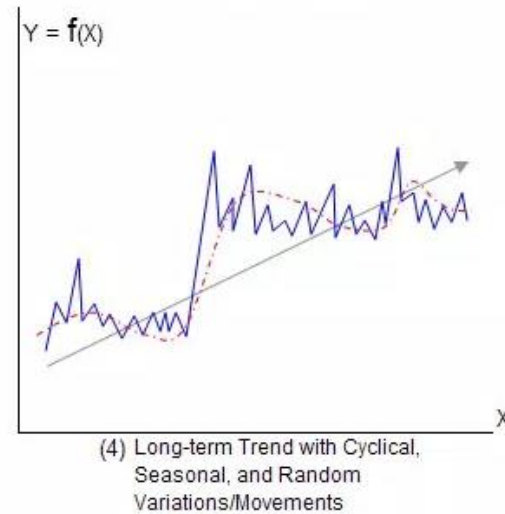
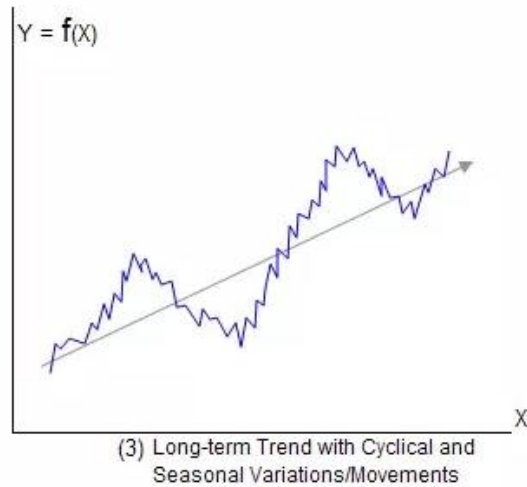
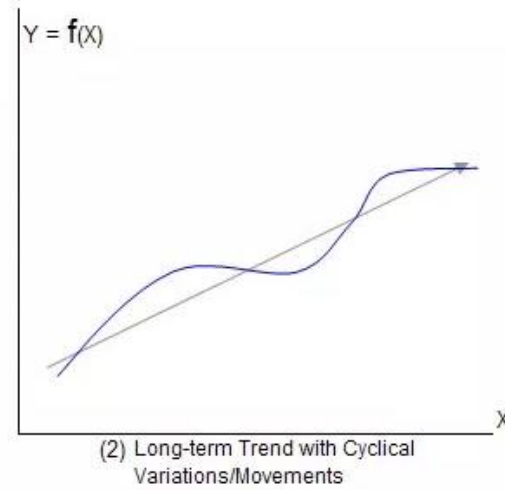
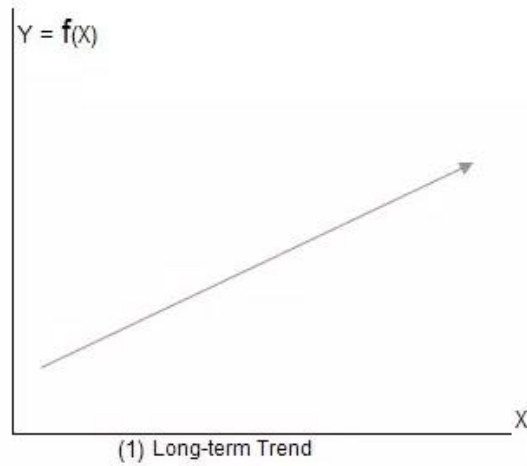
Q1	Time period	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21
	Sales(\$M)	1	1	1	1	1	1	1	1	1	?
Q2	Time period	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21
	Sales(\$M)	1	2	3	4	5	6	7	8	9	?
Q3	Time period	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21
	Sales(\$M)	1	5	1	5	1	5	1	5	1	?
Q4	Time period	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21
	Sales(\$M)	1	1	3	1	1	1	3	1	1	?
	Holidays	0	0	1	0	0	0	1	0	0	1

Components of Time series model

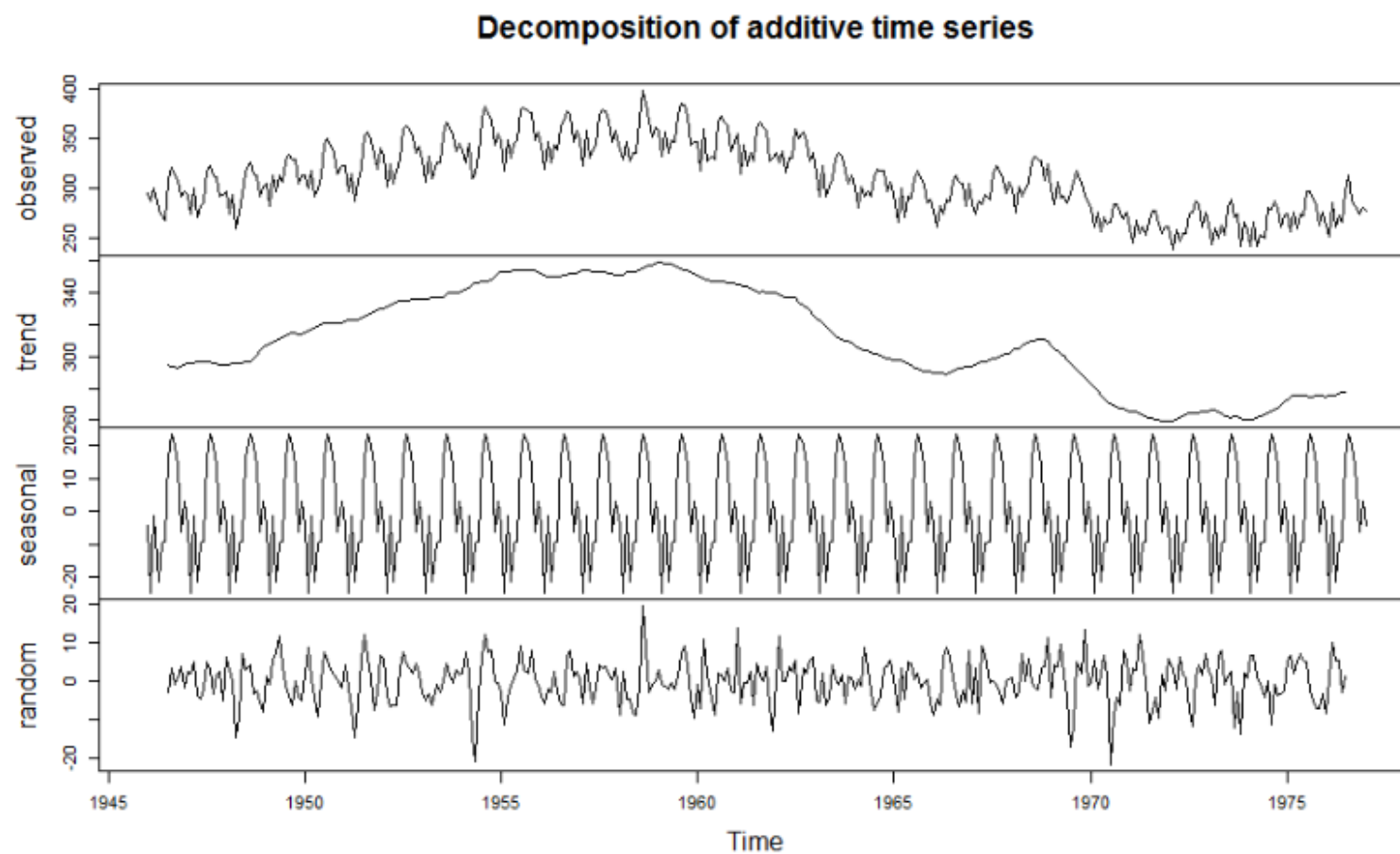
The various reasons or the forces which affect the values of an observation in a time series are the components of a time series. The four categories of the components of time series are



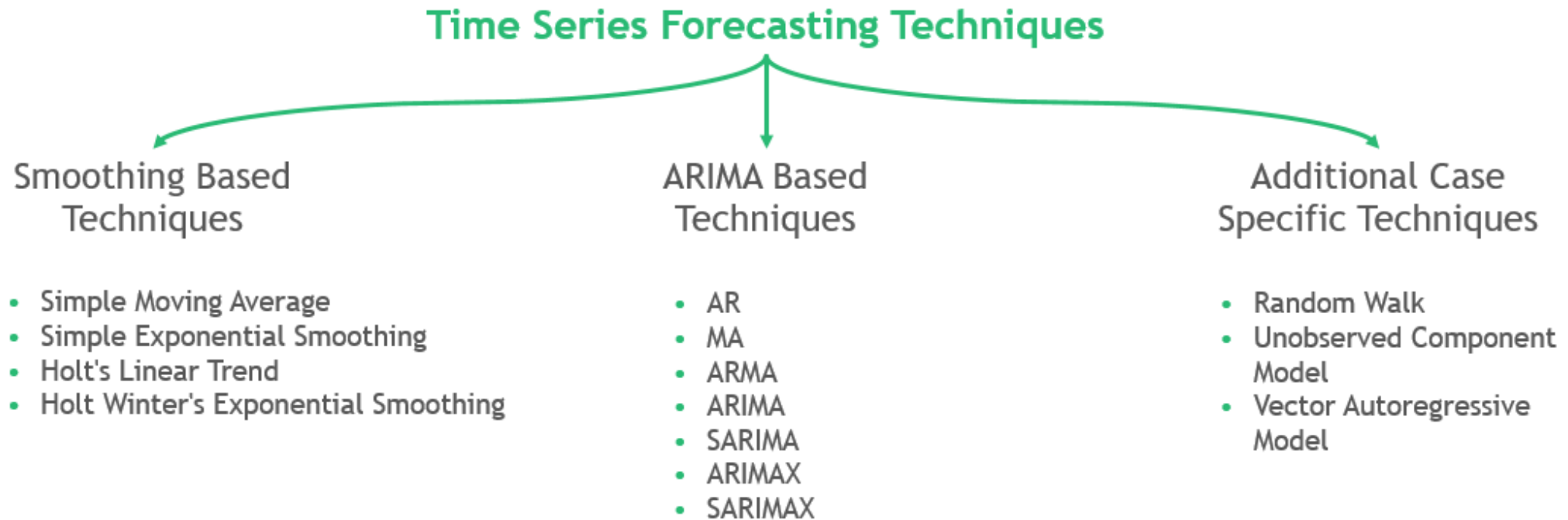
Components of Time series model



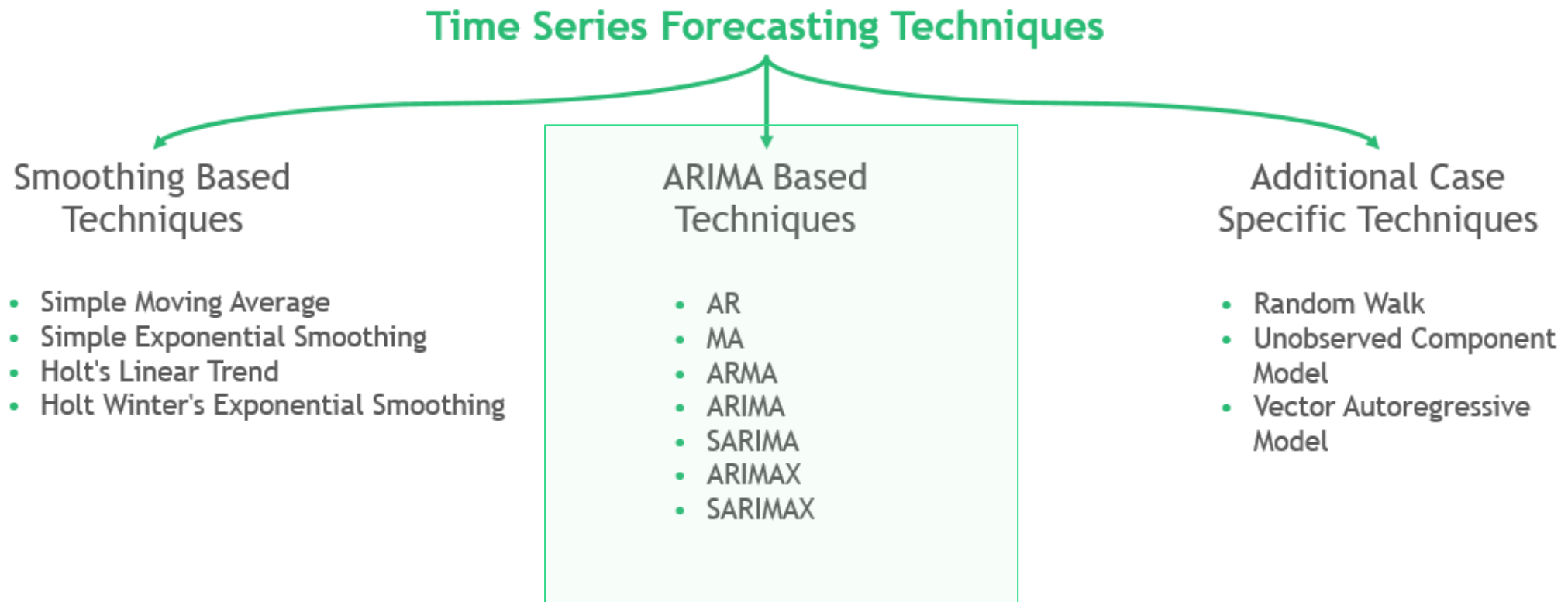
Decomposition of a time series



A lot of forecasting techniques to choose from



A lot of forecasting techniques to choose from



Introduction to ARIMA Models

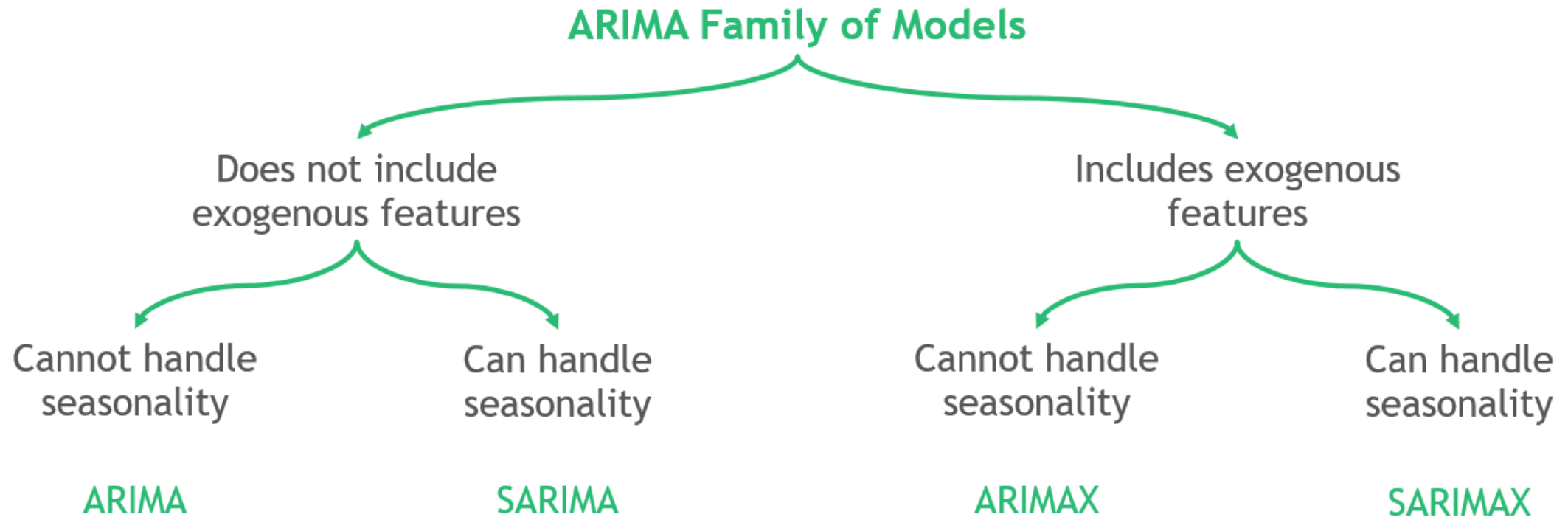
An ARIMA model is a class of statistical models for analyzing and forecasting time series data

This acronym is descriptive, capturing the key aspects of the model itself. Briefly, they are:

- **AR:** Autoregression
- **I:** Integrated
- **MA:** Moving Average

A key requirement for ARIMA models is stationarity of time series*

ARIMA Family of models



Forecasting quality scoring metrics

- R squared: coefficient of determination. This can be interpreted as variance explained by the model. Ranges from $(-\infty, 1]$
- Mean Absolute Error (MAE): It is mean of $\text{mod}(\text{actual} - \text{predicted value})$. This metric is easy to interpret as it has the same unit of measurement as the initial series. It can range from $[0, +\infty)$
- Mean Squared Error(MSE): This is mean of $(\text{actual} - \text{predicted})^2$. The squared error gives higher penalty to large deviations. This ranges from $[0, +\infty)$
- Mean Squared Logarithmic Error :This is practically same as MSE. However, we compute logarithm of the series while calculating this. It is used when data has exponential trends. It ranges from, $[0, +\infty)$
- Root mean squared error (RMSE): This is standard deviation of the residuals. Range: $[0, +\infty)$
- Mean Absolute Percentage Error(MAPE): This is MAE as a percentage of the actual. Range: $[0, +\infty)$



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