

# Time series **Forecasting**

The essential tools and concepts.

Time series are the new  
fortune tellers ! →

This notebook is made in servance of a time series workshop for GDSC-ESI-SBA ❤️

**November 19th 2022**



# A bit about me ?

## Final year CS engineering student

- ESI-ALGER (Algiers, Algeria)
- Computer systems
- Masters and state-engineering degrees at preparation

## AI R&D research assistant

- INFOLOGIC Engineering (Lyon, France)
- Working on predicting different failures in datacenters and cloud systems using AI

## Entrepreneurial kiddo

- Ex. dev team leader at ETIC Club
- Candidate for several engineer-entrepreneur trainings

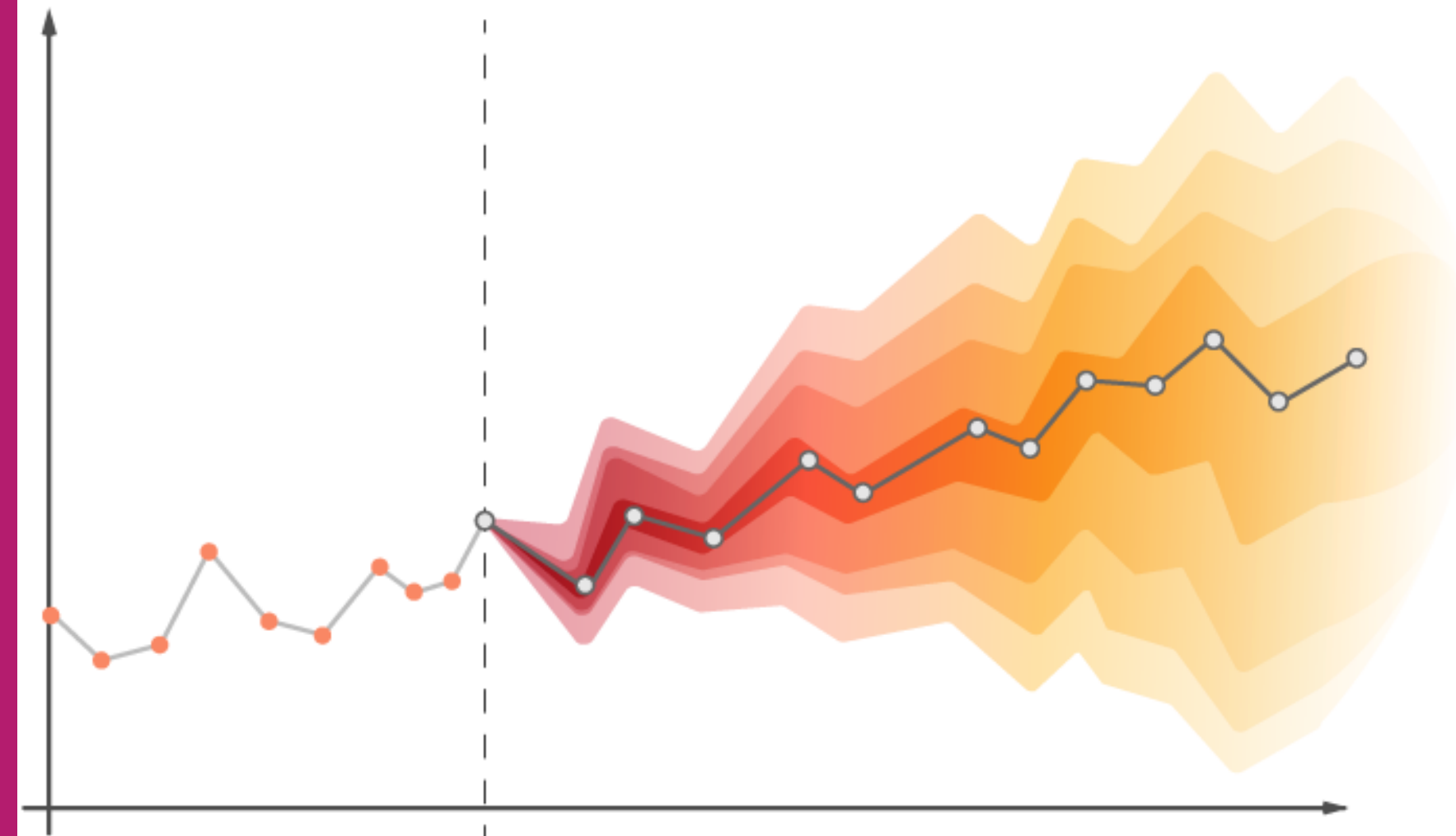
# What are **time series** anyways ?

- Any data recorded with some fixed interval of time is called as time series data.
- In time series data, time will always be independent variable and there can be one or many dependent variable.



# The goal behind forecasting them ?

- Objective of time series analysis is to understand how change in time affect the dependent variables and accordingly predict values for future time intervals.



# 3 Main components

## Trend

Trend represent the change in dependent variables with respect to time from start to end.

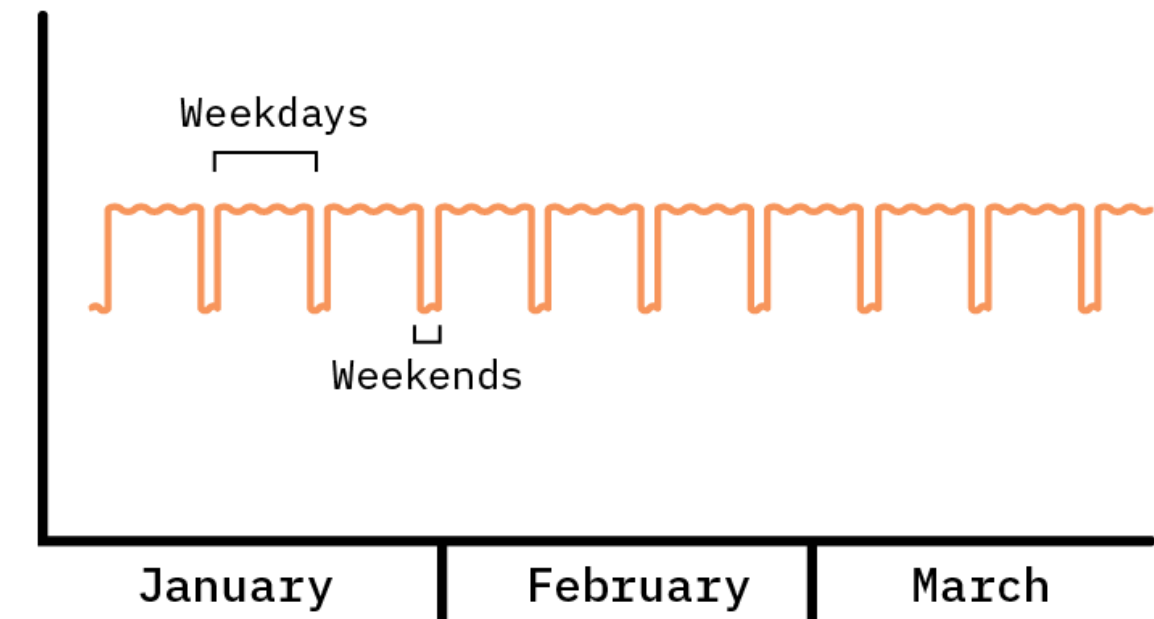
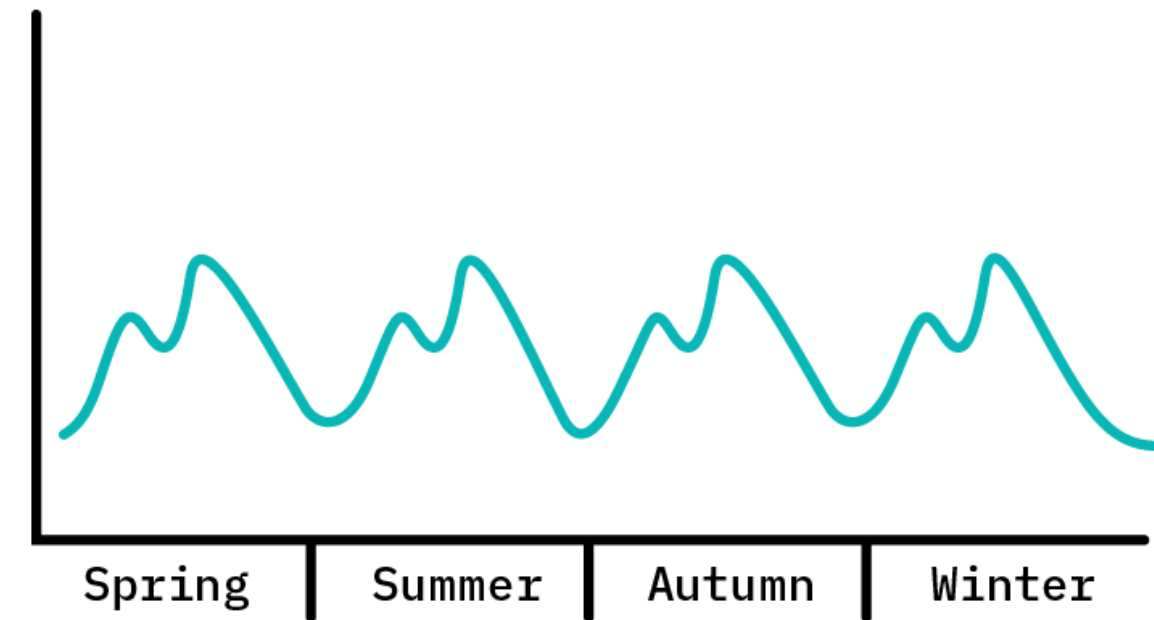
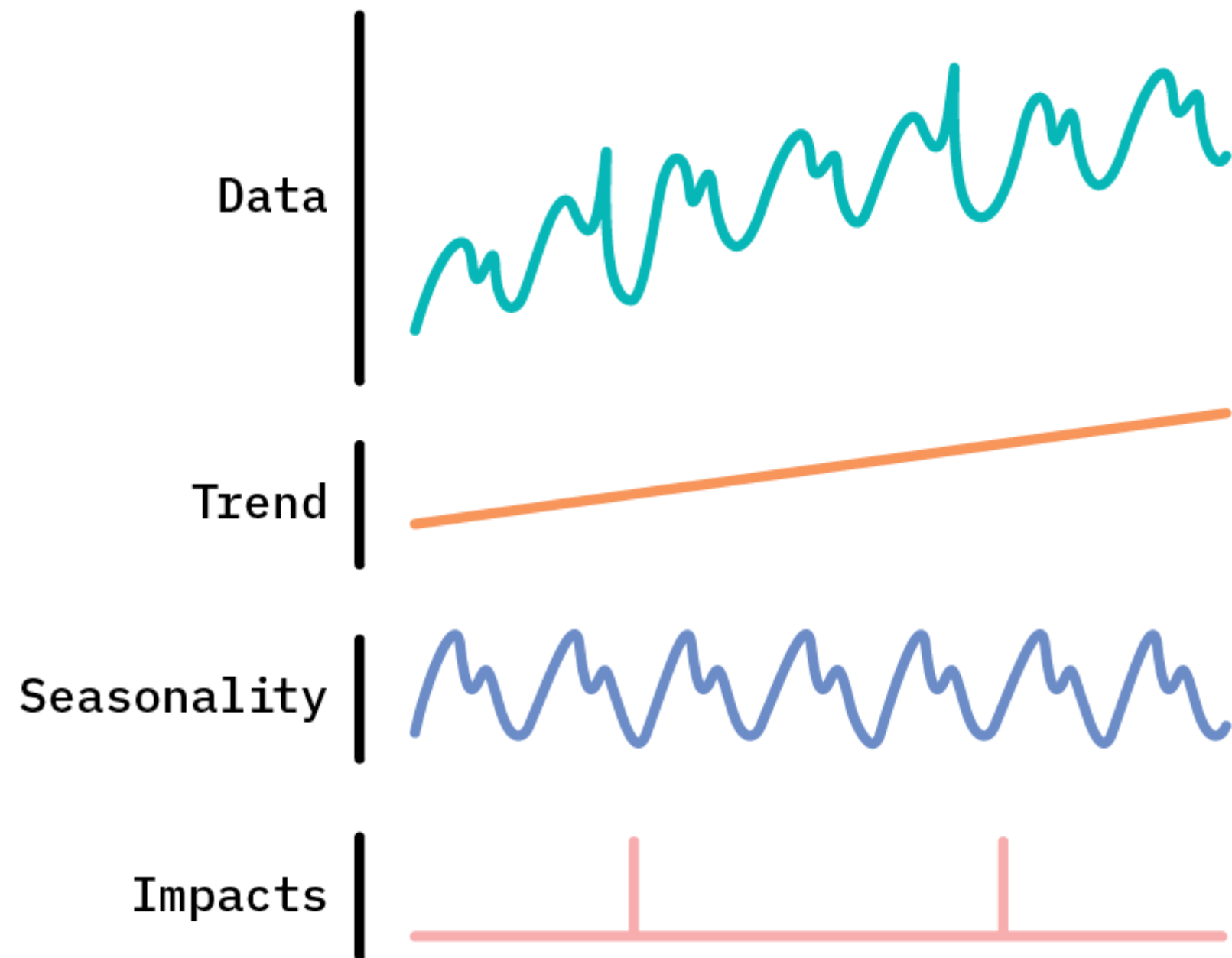
## Seasonality

If observations repeats after fixed time interval then they are referred as seasonal observations.

## Residuals

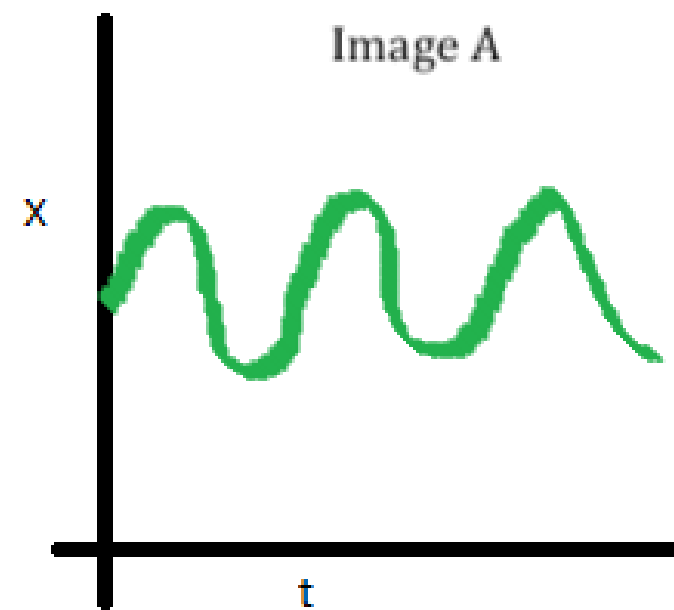
This is also called as noise. Strange dips and jump in the data are called as irregularities. They are caused by uncontrollable events

# 3 Main components

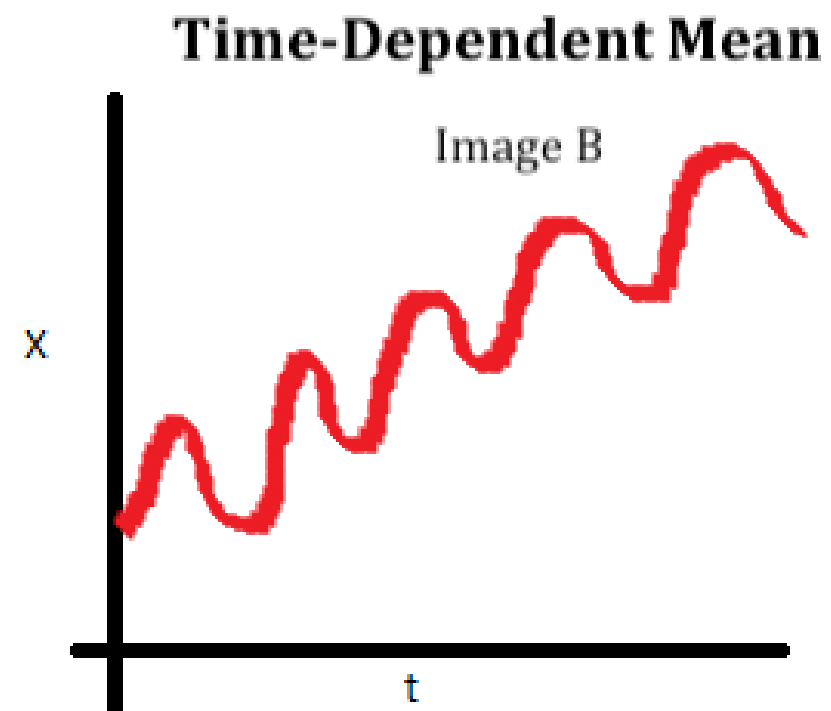


# Transform to stationary ts

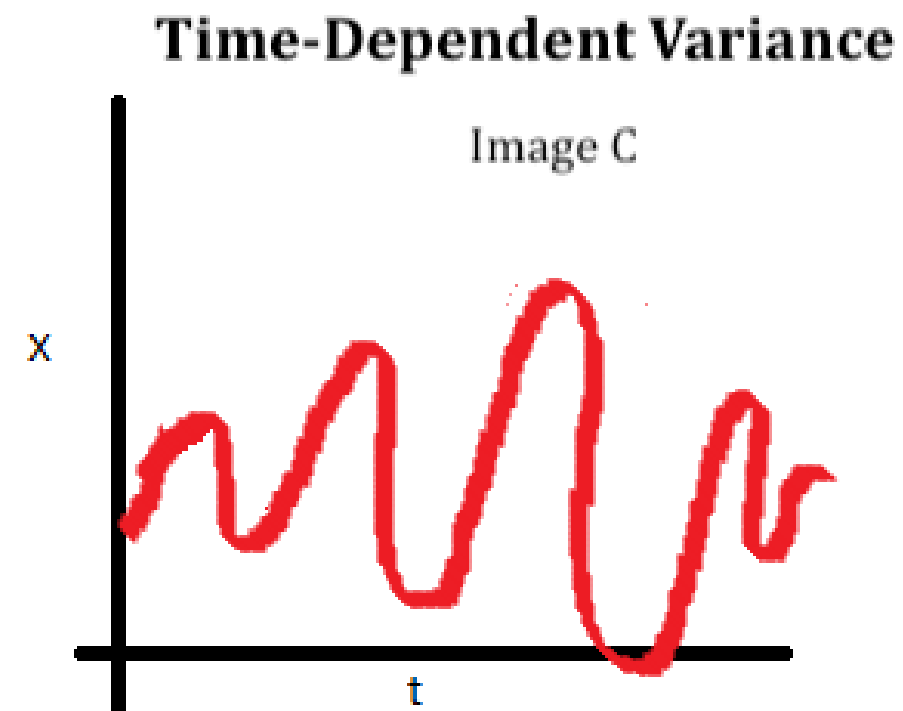
## The Principles of Stationarity



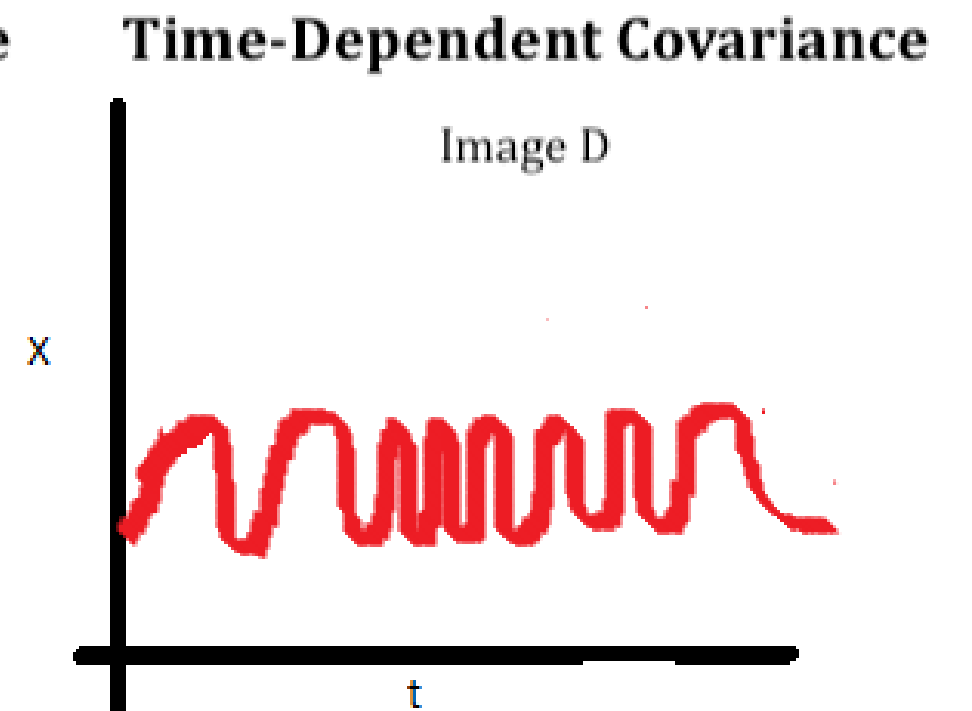
Stationary series



Non-Stationary series



Non-Stationary series



Non-Stationary series

# Stationarity test - transformation

ADF Test	<ul style="list-style-type: none"><li>• <math>p\text{-value} &gt; 0.05</math>: non-stationary.</li><li>• <math>p\text{-value} \leq 0.05</math>: stationary.</li></ul>
Differencing	<ul style="list-style-type: none"><li>• Removes trend and seasonality</li><li>• <math>\text{difference} = \text{previous observation} - \text{current observation}</math></li></ul>
Transformation	<ul style="list-style-type: none"><li>• apply a power transformation to the time series. Log, square root, cube root are most commonly used transformation techniques.</li></ul>



# Stationarity test - transformation

Moving Average	<ul style="list-style-type: none"><li>a new series is created by taking the averages of data points from original series.</li></ul>
Weighted moving average	<ul style="list-style-type: none"><li>The WMA is obtained by multiplying each number in the data set by a predetermined weight and summing up the resulting values.</li><li>The weights privilege most recent data</li></ul>
Trailing Moving Averages	<ul style="list-style-type: none"><li>instead of averaging over a window that is centered around a time period of interest, it simply takes the average of the last w values.</li><li><math>TMA(t) = \text{mean}(t-2, t-1, t)</math></li></ul>

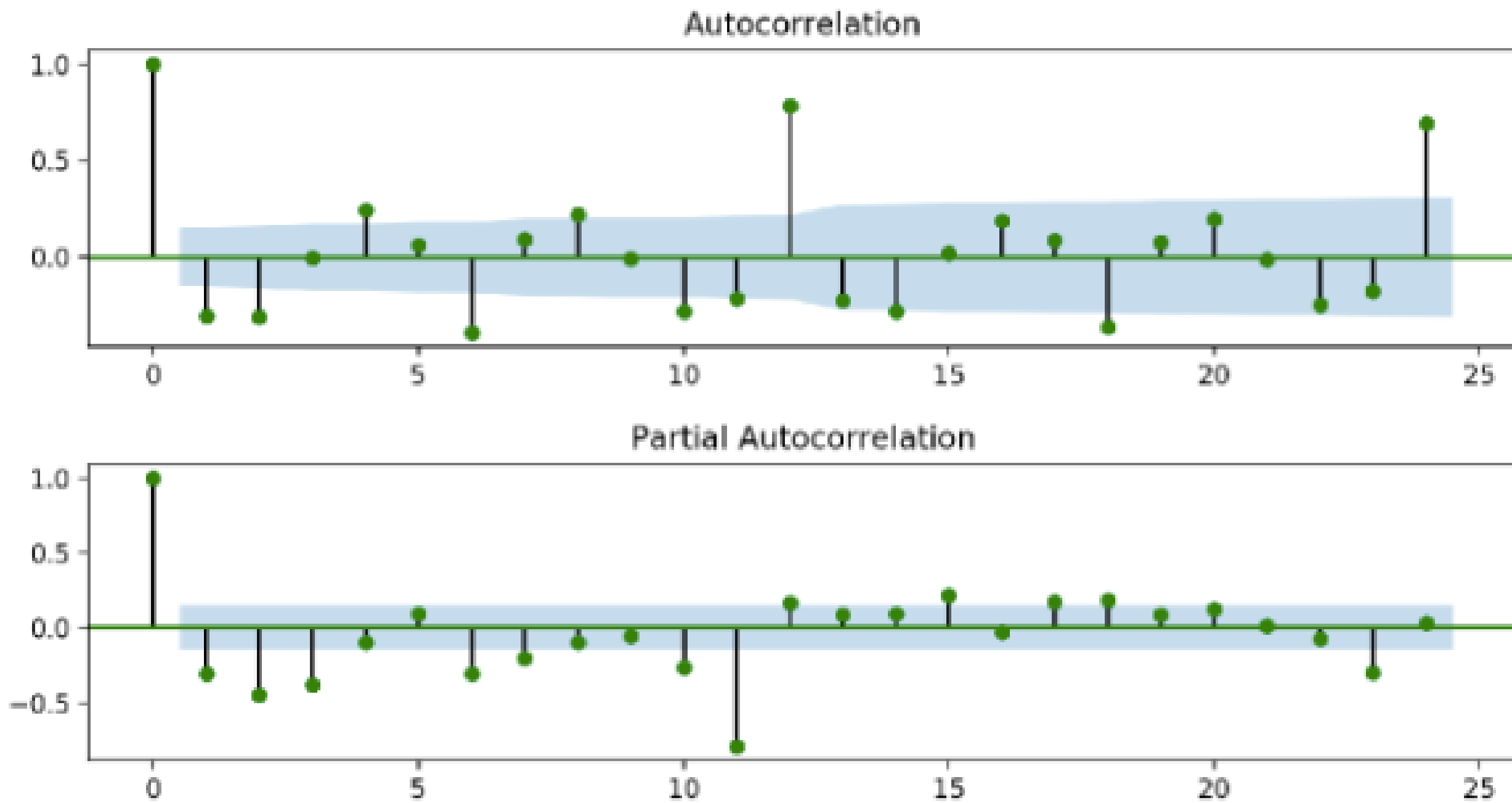
# Correlation in time series data

- Values in TS exhibit correlation with previous ones
- Because the correlation of the time series observations is calculated with values of the same series at previous times, this is called an autocorrelation or serial correlation.

# Correlation in time series data

- All the past and future data points are related in time series and ACF and PACF functions help us to determine correlation in it.

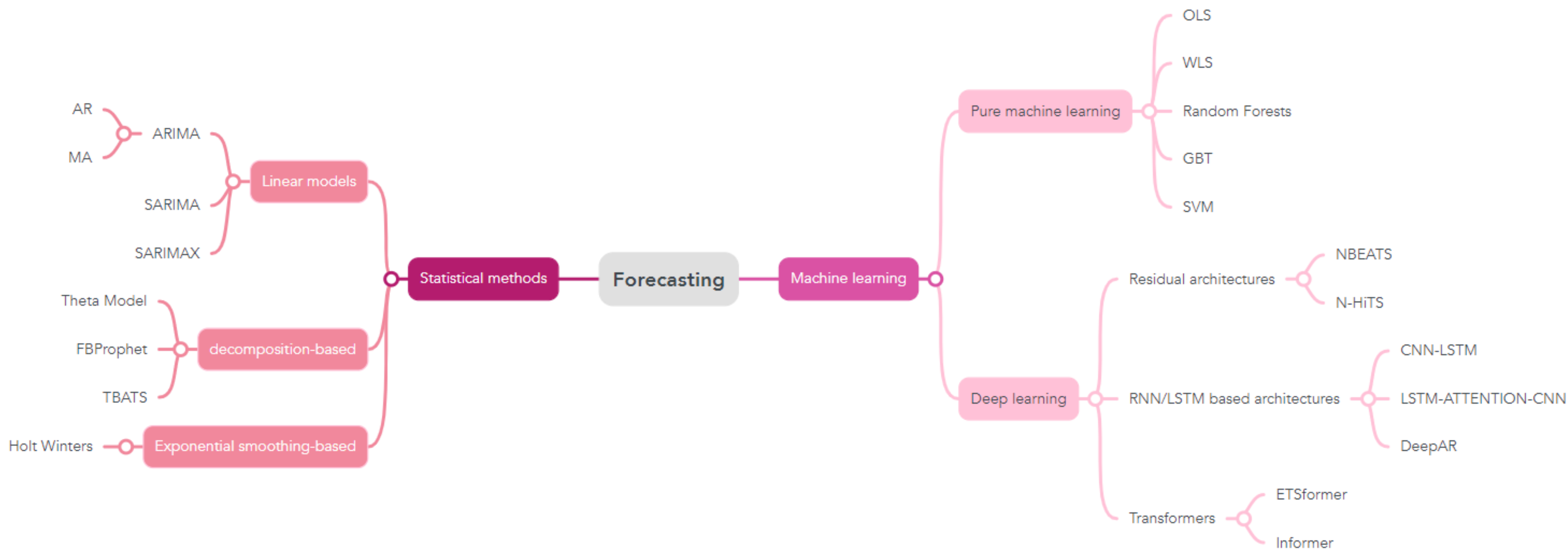
# Plot of PACF and ACF



# Steps to conduct a forecasting

- ☐ Understand the trend and seasonality
- ☐ Identify best way to make ts stationary
- ☐ Make sure the reverse transformation exists
- ☐ Choose
- ☐ Choose the model performance metric
- ☐ Make sure to use the whole data for prediction
- ☐ Apply reverse transformation to get back to original data scale
- ☐ Forecast future values

# Methods for TS Forecasting



**Thanks!**

**Questions ?**

**CODE TIME**  
**FELLAS !**

