# Anàlisi temporal amb Machine learning

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1. Representació d’estats
2. Comparació de sèries temporals mateixa mida
3. Comparació de sèries temporals diferent mida
4. Visualitzacions gràfiques de time series

## 1. Representació d’estats

- Decrementa, estacionari i incrementa

**Artificial intelligence** and earth observation to explore water quality in the **Wadden Sea**

## 1. Representació d'estats

- Decrementa, estacionari i incrementa
- Incrementa fortament, incrementa suaument, etc.

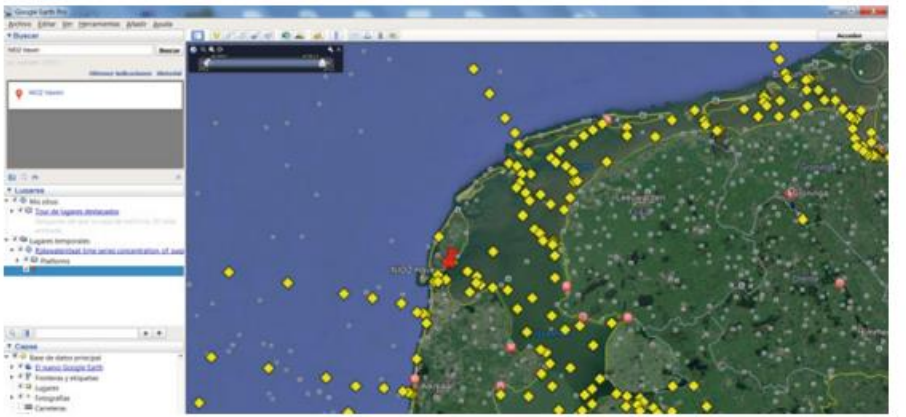
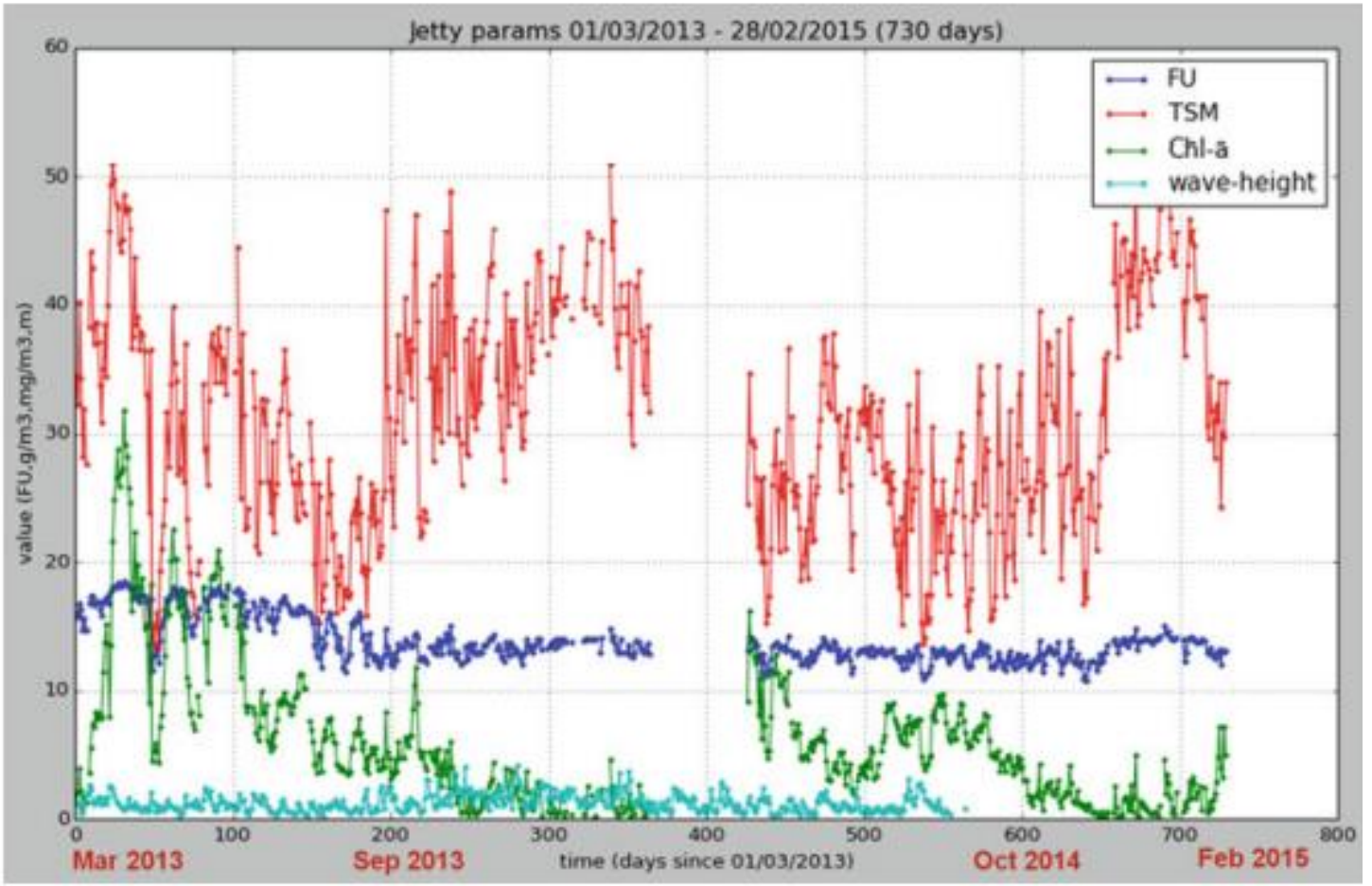



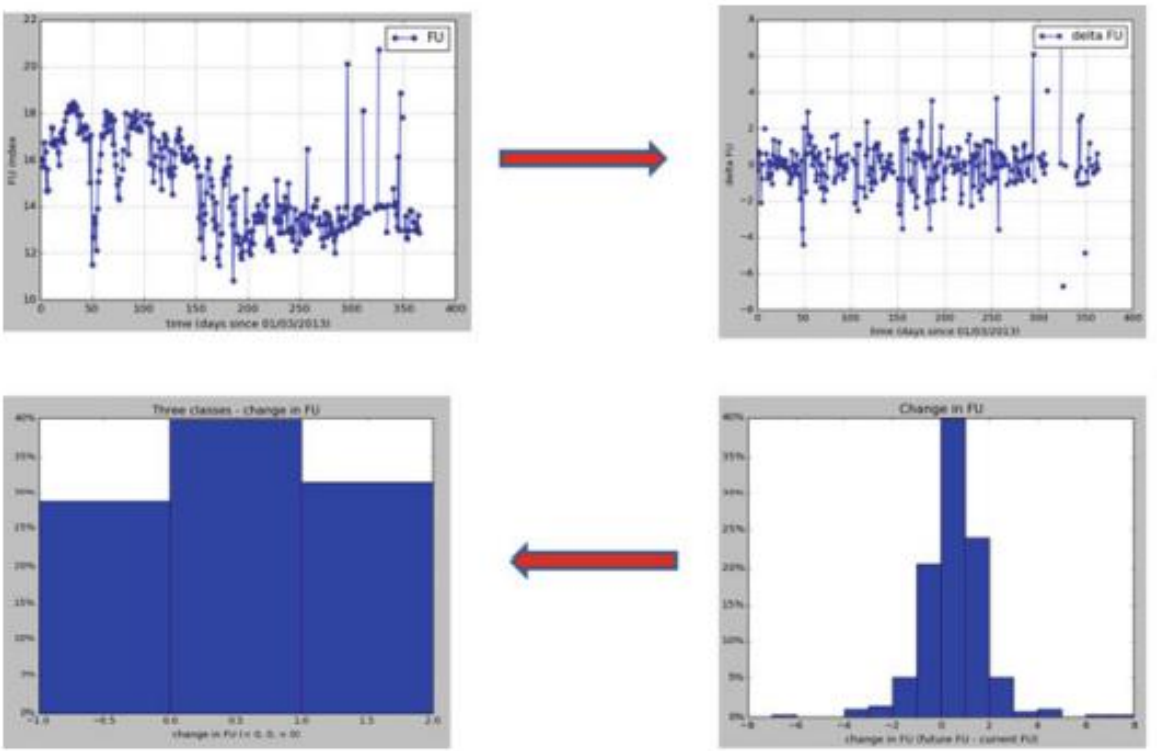
**Fig. 1** In situ monitoring platform: *yellow markers* indicate the Dutch national water quality monitoring network (Rijkswaterstaat); the *red pin* (NIOZ jetty) indicates the location of the observation platform of the Royal Netherlands Institute of Sea Research (NIOZ). Source: http://kml.deltares.nl/kml/rijkswaterstaat/waterbase/concentration_of_suspended_matter_in_water.kml and Google Earth

# 1. Representació d'estats



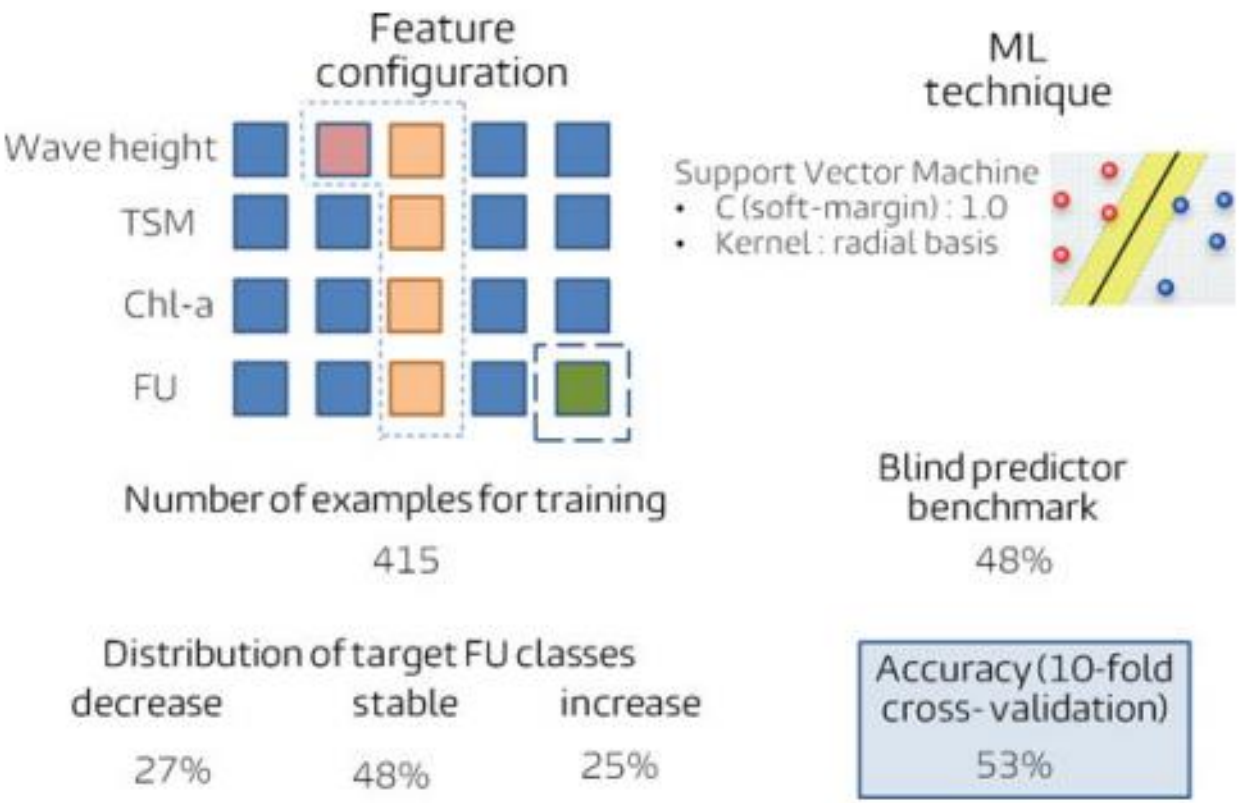
## 1. Representació d'estats

- A model of the target variable "FU colour" at future points (2 days, 4 days, 7 days) has been learned



## 1. Representació d'estats

- The target-value attribute is FU at 2 days into the future, and the input vector includes the following attributes: wave height, TSM, Chl-a, FU at the current time point, and wave height at 1 day in the past.



## 1. Representació d'estats

- Incrementa suaument, decrementa suaument, etc.
- Intervals d'Allen: 13 possibles relacions

| Relation | Symbol | Inverse | Meaning |
|---|---|---|---|
| x before y | b | bi |  |
| x meets y | m | mi |  |
| x overlaps y | o | oi |  |
| x during y | d | di |  |
| x starts y | s | si |  |
| x finishes y | f | fi |  |
| x equal y | eq | eq |  |

## 1. Representació d'estats

- Estandarització
- Diferents aproximacions temporals:
  - Estat anterior
  - Llarg termini
  - Canvi d'estats
- Es pot indicar l'estat inicial

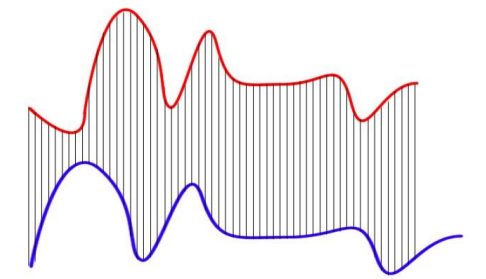
## 2. Comparació de sèries temporals mateixa mida

- Distància euclidea

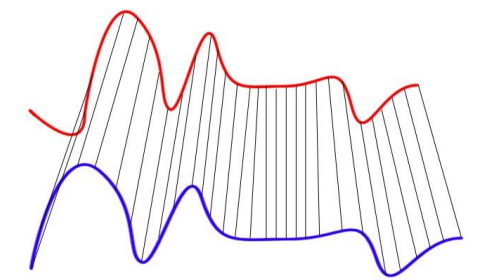
https://www.geeksforgeeks.org/how-to-calculate-euclidean-distance-in-r/

## 3. Comparació de sèries temporals amb diferent mida

- Dynamic Time Warping is used to compare the similarity or calculate the distance between two arrays or time series with different length.



Euclidean Matching

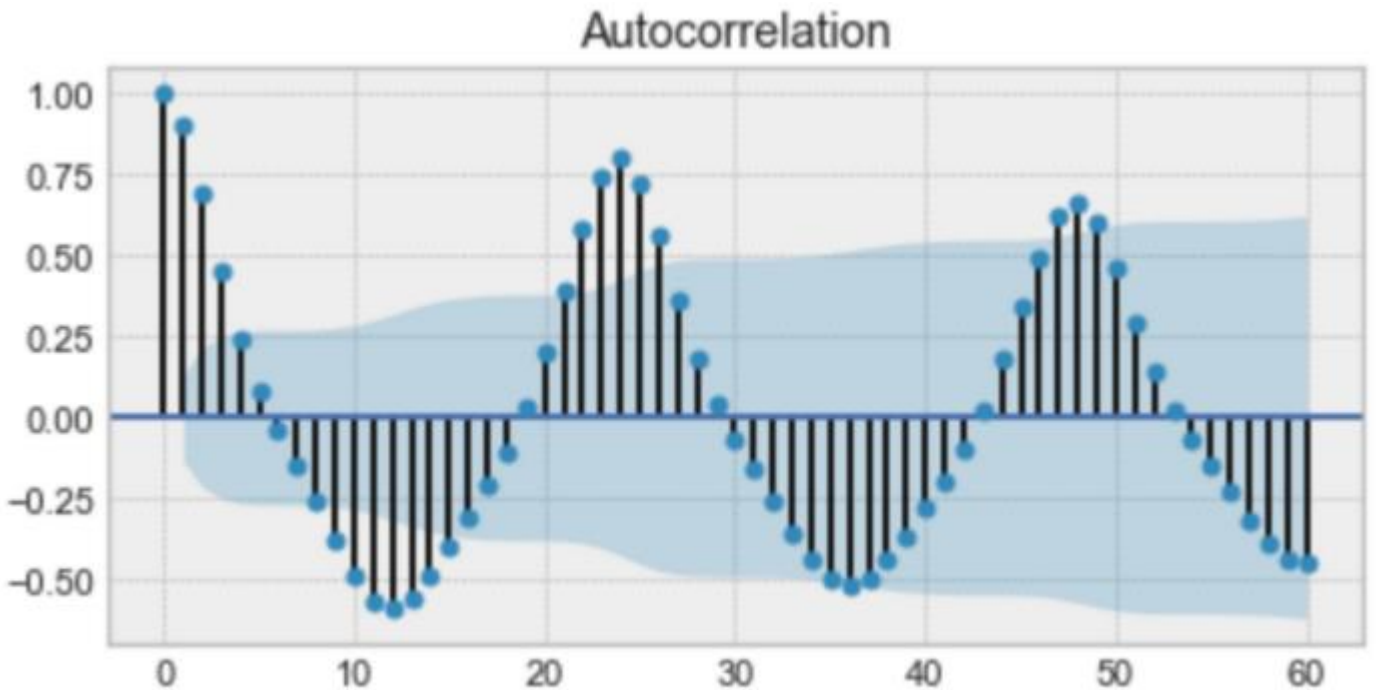


Dynamic Time Warping Matching

https://dtw.r-forge.r-project.org

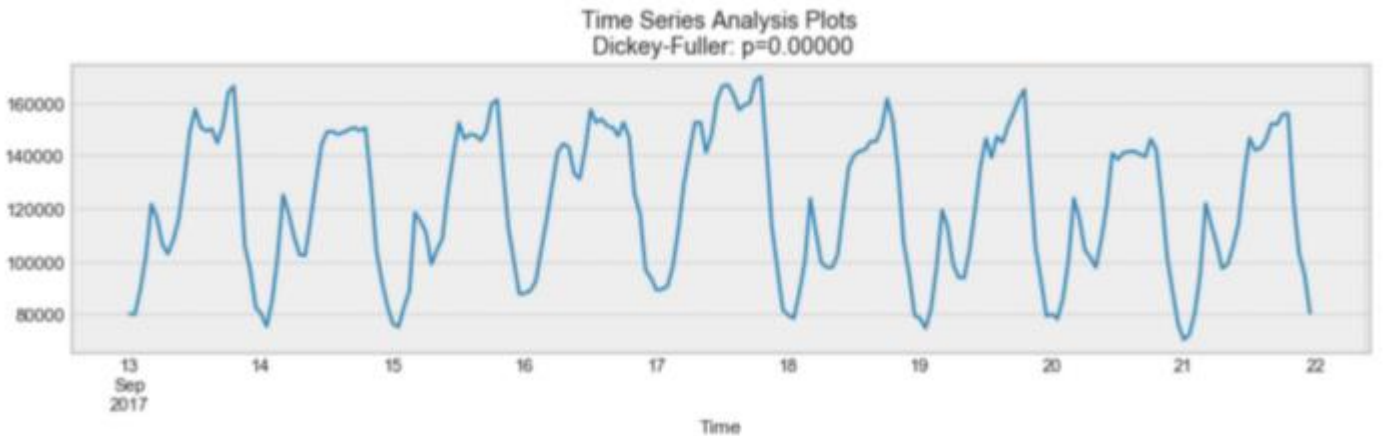
## 4. Complete guide

- Autocorrelation: Informally, **autocorrelation** is the similarity between observations as a function of the time lag between them.



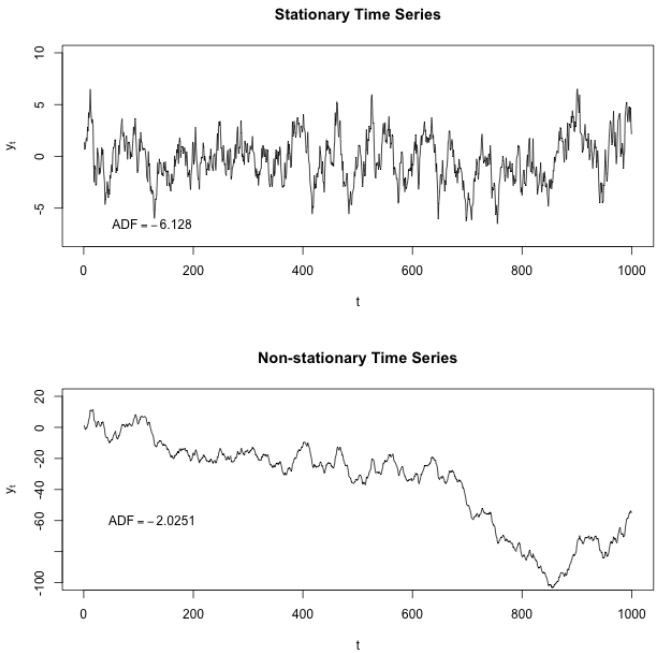
## 4. Complete guide

- Seasonality: **Seasonality** refers to **periodic fluctuations**. For example, electricity consumption is high during the day and low during night, or online sales increase during Christmas before slowing down again.

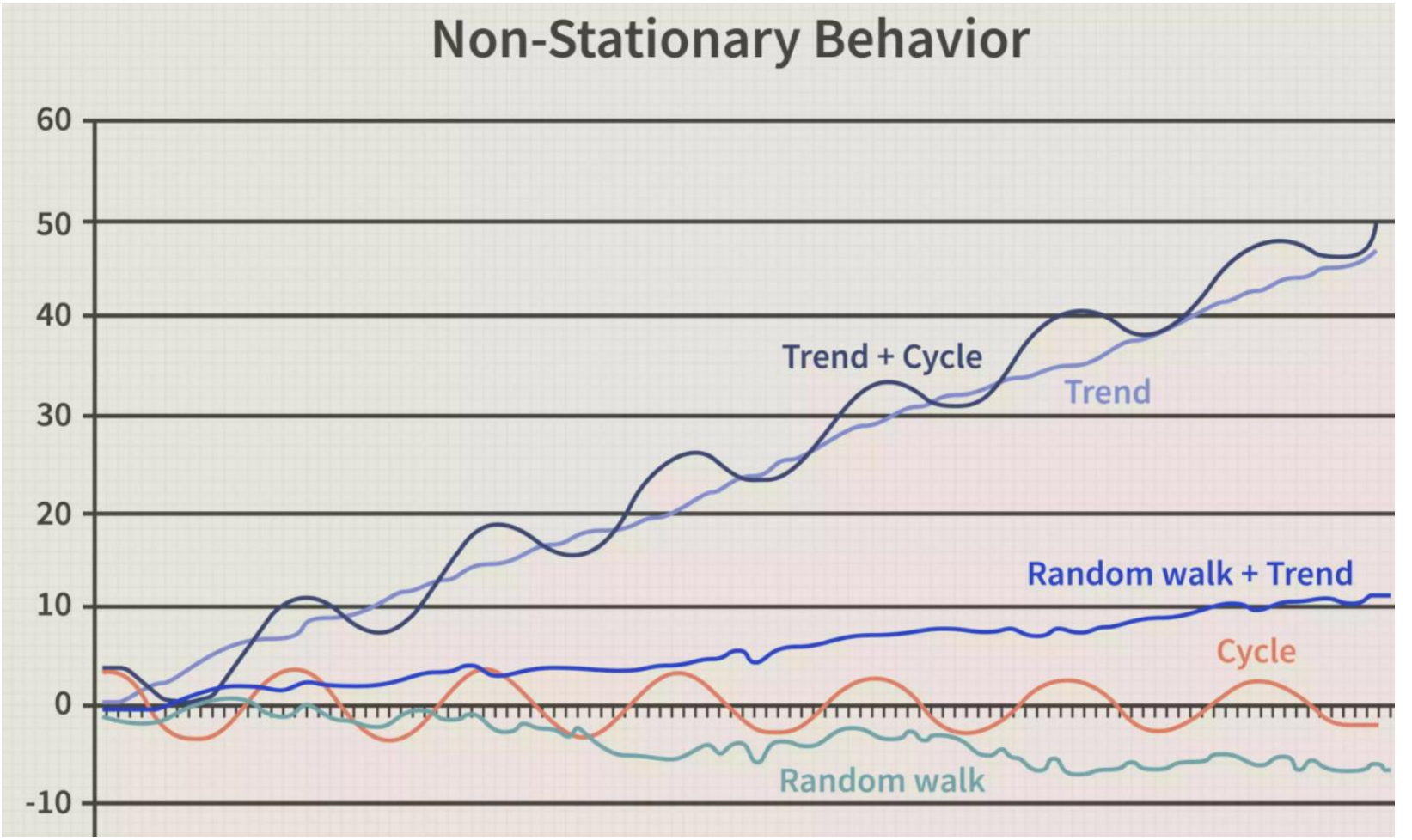


## 4. Complete guide

- **Stationarity** is an important characteristic of time series. A time series is said to be stationary if its statistical properties do not change over time. In other words, it has **constant mean and variance**, and covariance is independent of time.



# 4. Complete guide



## 4. Complete guide

- In this website there is a complete guide of time analysis
  - moving average

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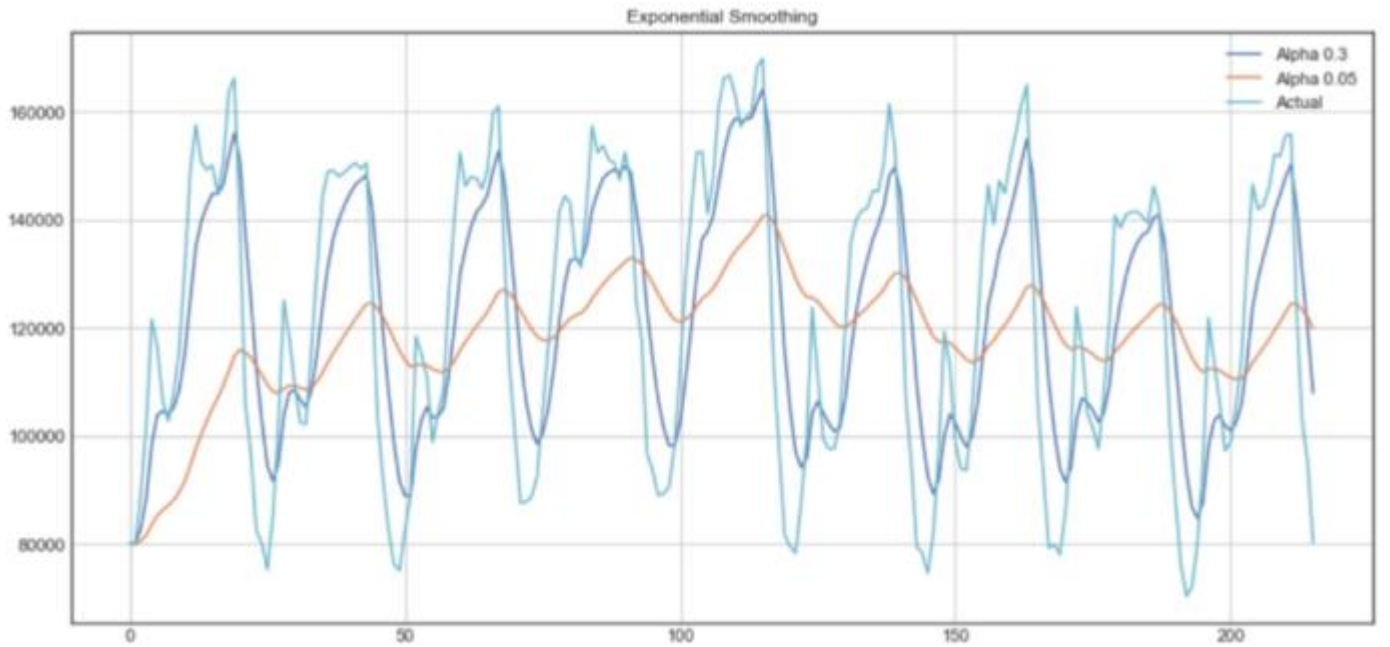
- In this website there is a complete guide of time analysis
  - exponential smoothing



# 4. Complete guide

- Autoregressive model i ARIMA

### Example: An AR(1) process [edit]

An AR(1) process is given by:

$$X_t = c + \varphi X_{t-1} + \varepsilon_t$$

where $\varepsilon_t$ is a white noise process with zero mean and constant variance $\sigma_\varepsilon^2$. (Note: The subscript on $\varphi_1$ has been dropped.) The process is wide-sense stationary if $|\varphi| < 1$ since it is obtained as the output of a stable filter whose input is white noise. (If $\varphi = 1$ then the variance of $X_t$ depends on time lag t, so that the variance of the series diverges to infinity as t goes to infinity, and is therefore not wide sense stationary.) Assuming $|\varphi| < 1$, the mean $\mathrm{E}(X_t)$ is identical for all values of $t$ by the very definition of wide sense stationarity. If the mean is denoted by $\mu$, it follows from

$$\mathrm{E}(X_t) = \mathrm{E}(c) + \varphi\,\mathrm{E}(X_{t-1}) + \mathrm{E}(\varepsilon_t),$$

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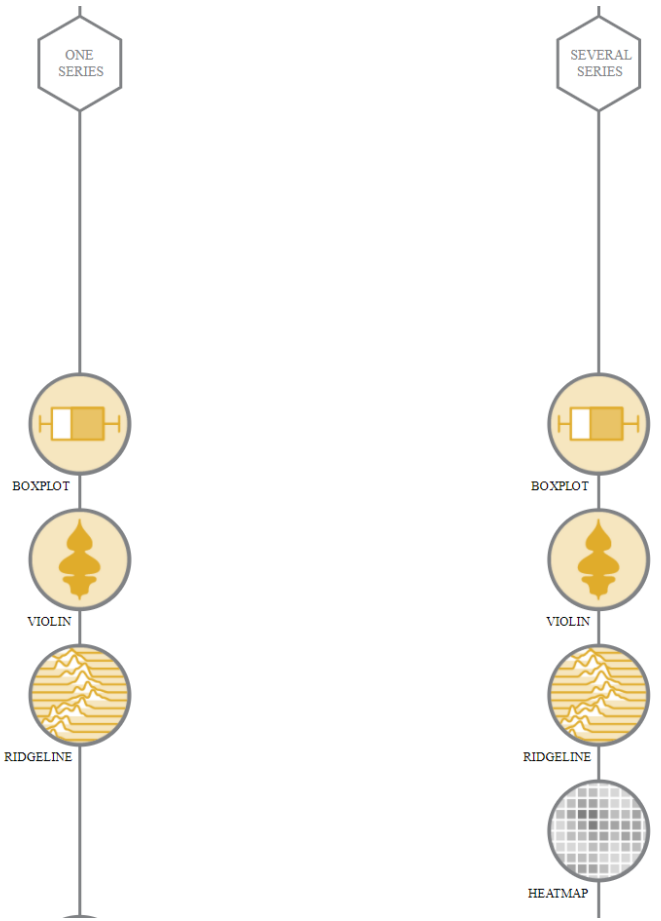
The notation $AR(p)$ indicates an autoregressive model of order $p$. The AR($p$) model is defined as

$$X_t = c + \sum_{i=1}^{p} \varphi_i X_{t-i} + \varepsilon_t$$

https://machinelearningmastery.com/time-series-forecasting/

## 5. Gràfiques time series

- https://www.data-to-viz.com/



**Gràcies per la vostra col·laboració!**

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