Ajuntament de Barcelona

Anàlisi temporal amb Machine learning

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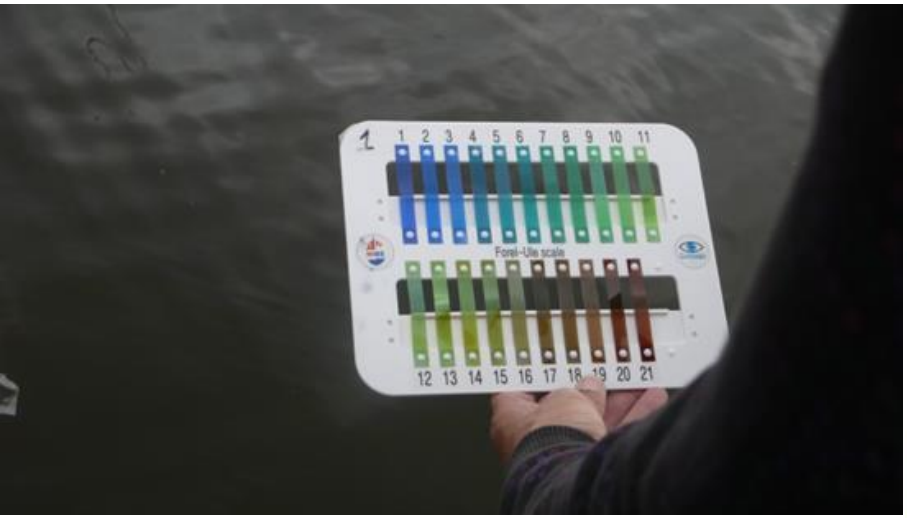
1. Representació d'estats

- 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.



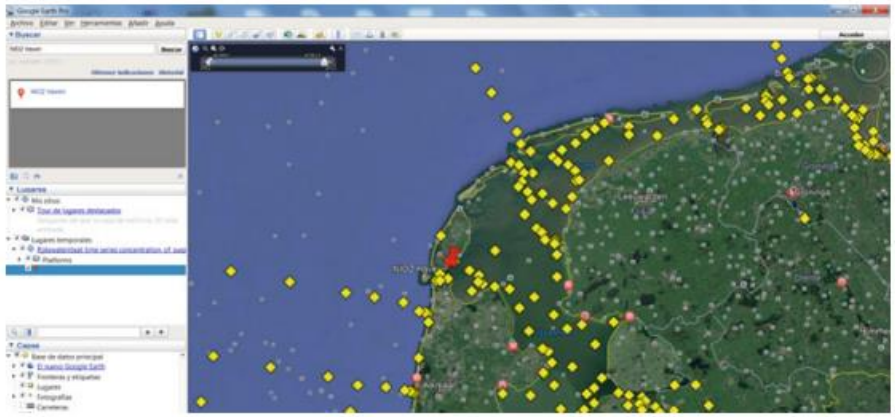
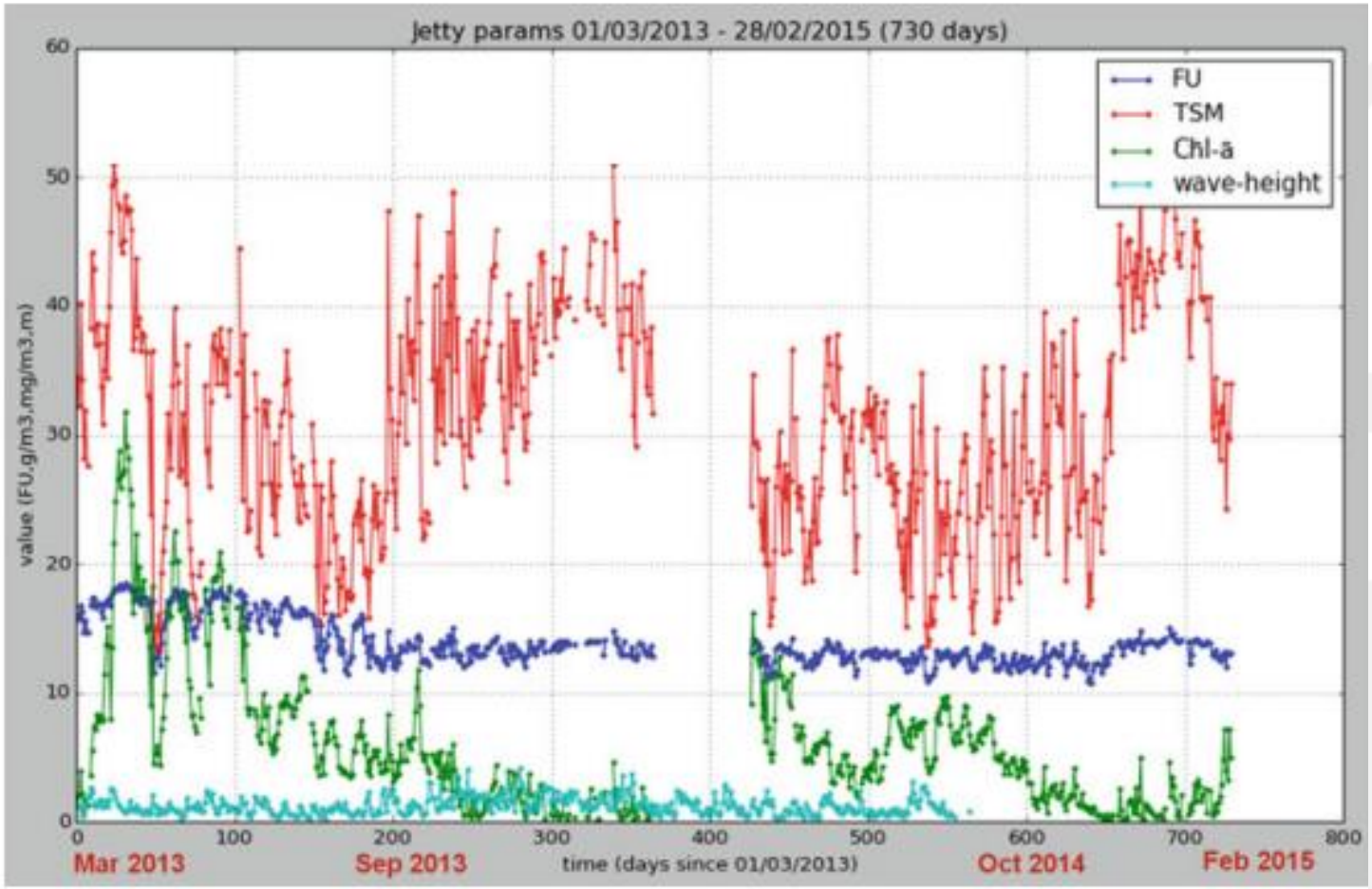


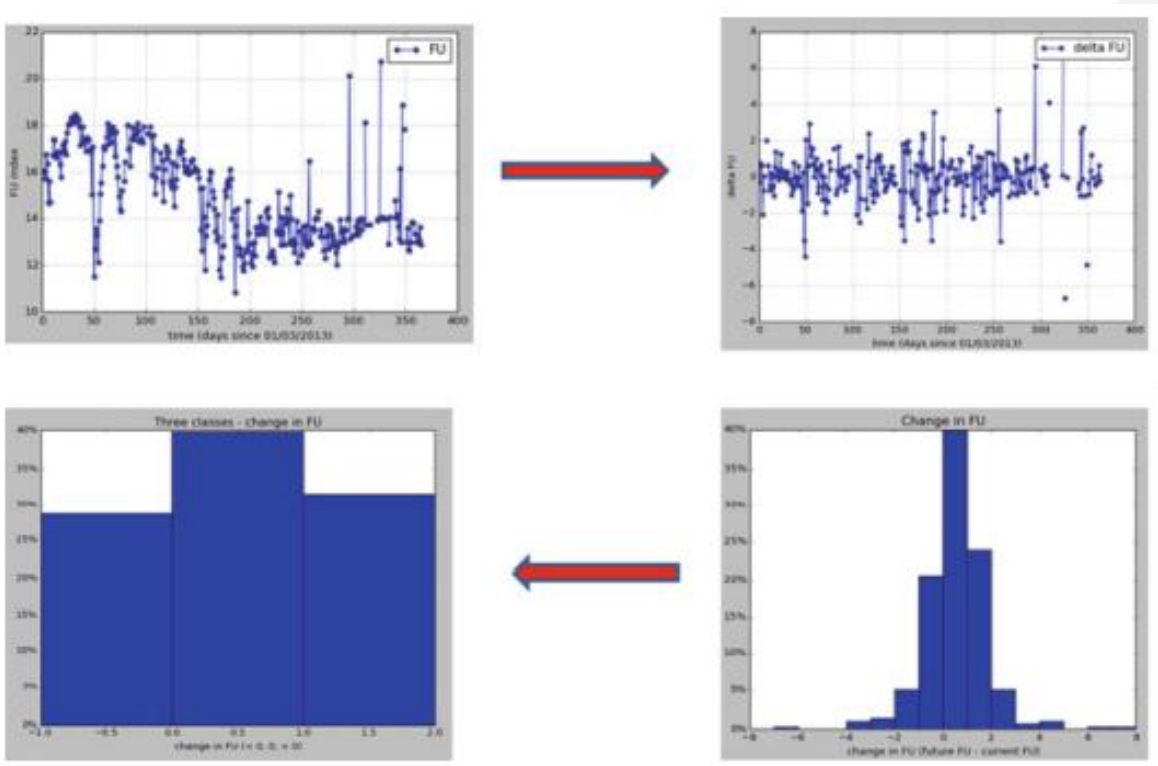
Fig. 1 In situ monitoring platform: *yellow markers* indicate the Dutch national water quality monitoring network (Rijkswaterstaat); the *red pin* (NIOZ jetty) indicates the location of the observation platform of the Royal Netherlands Institute of Sea Research (NIOZ). Source: http://kml.deltares.nl/kml/rijkswaterstaat/waterbase/concentration_of_suspended_matter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

1. Representació d'estats



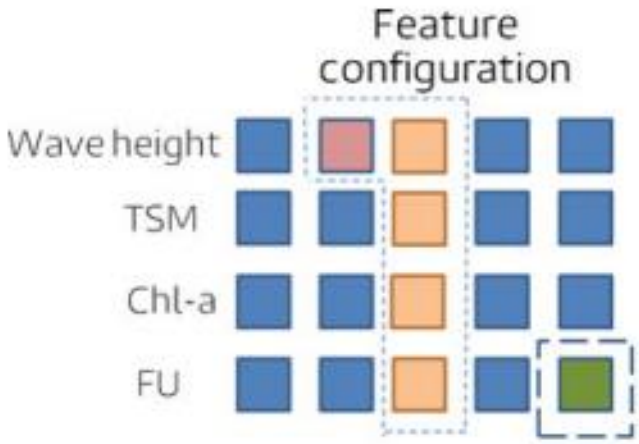
1. Representació d'estats

- 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.



ML technique

Support Vector Machine
- C (soft-margin) : 1.0
- Kernel : radial basis

Number of examples for training

415

Blind predictor benchmark

48%

Distribution of target FU classes

decrease	stable	increase
27%	48%	25%

Accuracy (10-fold cross-validation)

53%

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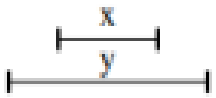
1. Representació d'estats

- 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

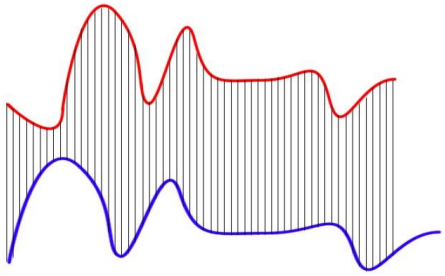
2. Comparació de sèries temporals mateixa mida

- Distància euclidea i altres distàncies

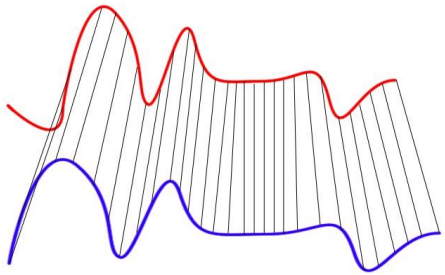
https://docs.scipy.org/doc/scipy/reference/generated/scipy.spatial.distance.euclidean.html
https://docs.scipy.org/doc/scipy/reference/spatial.distance.html

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://towardsdatascience.com/dynamic-time-warping-3933f25fcdd

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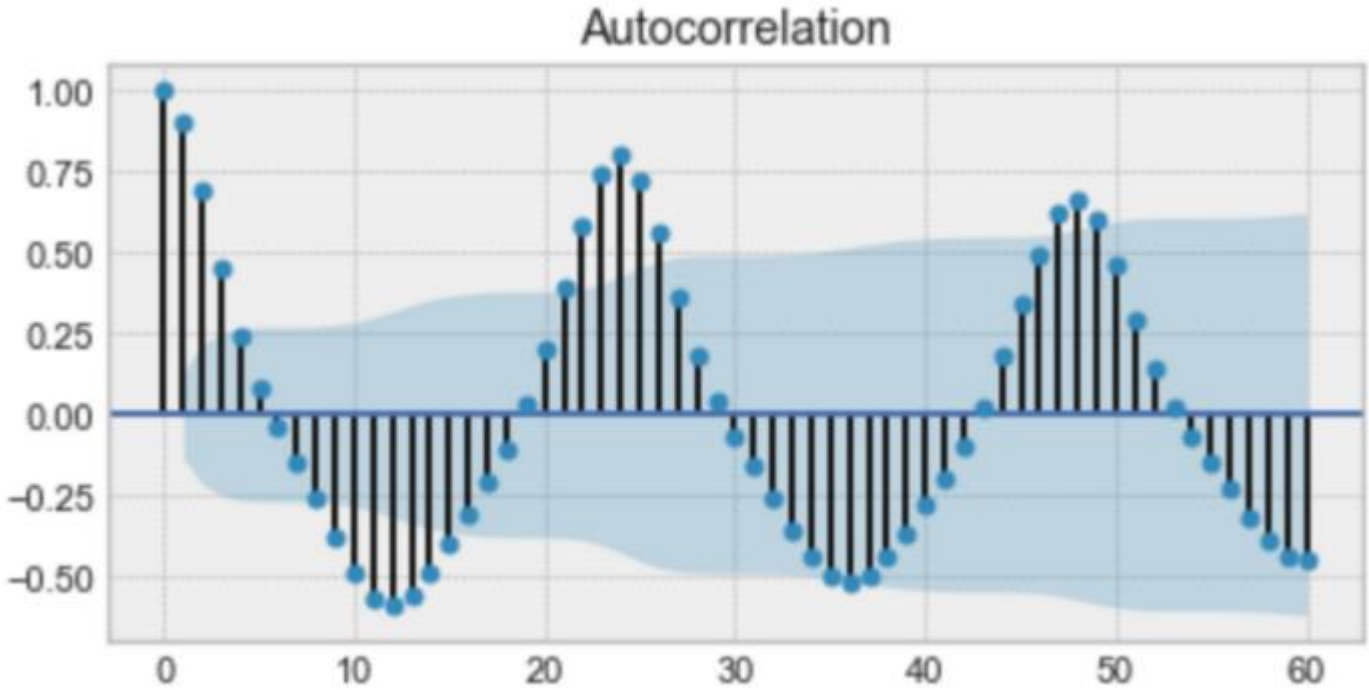
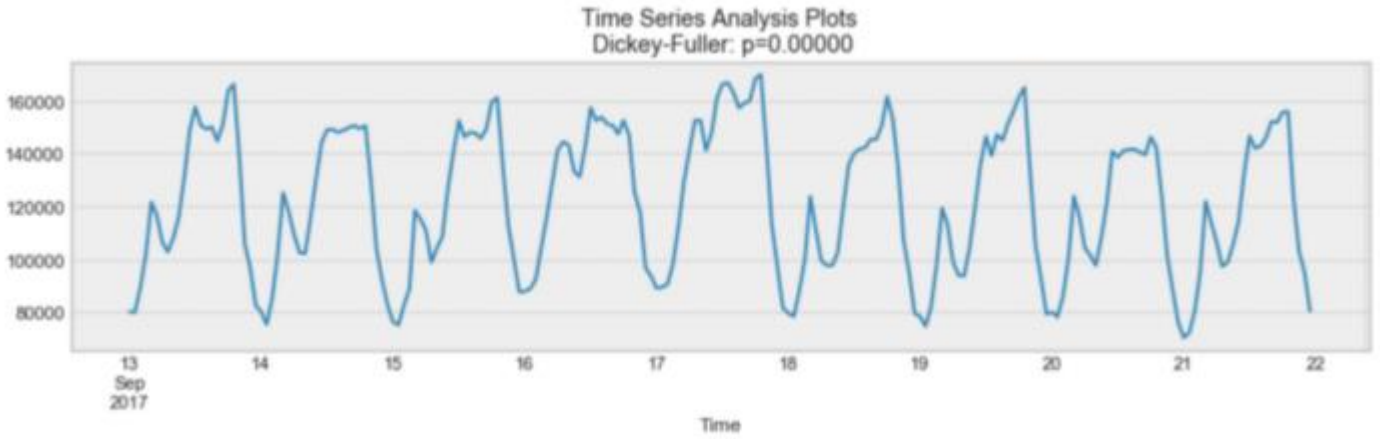
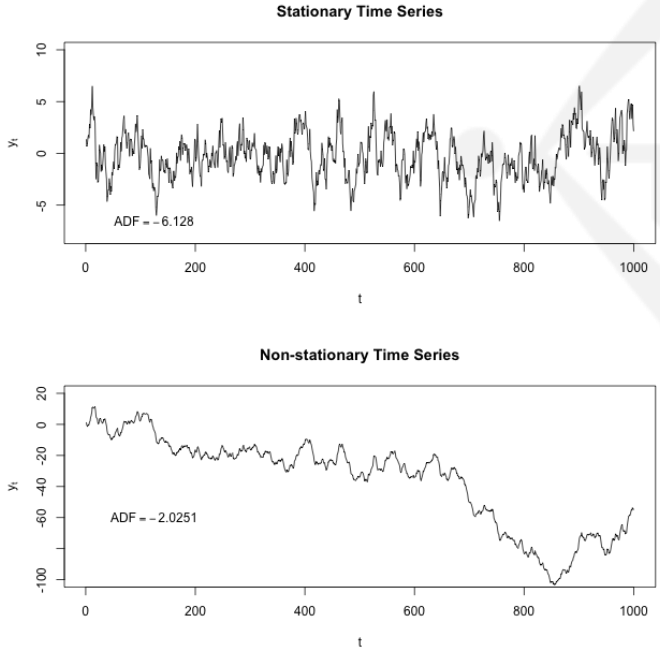
- Autocorrelation: Informally, **autocorrelation** is the similarity between observations as a function of the time lag between them.



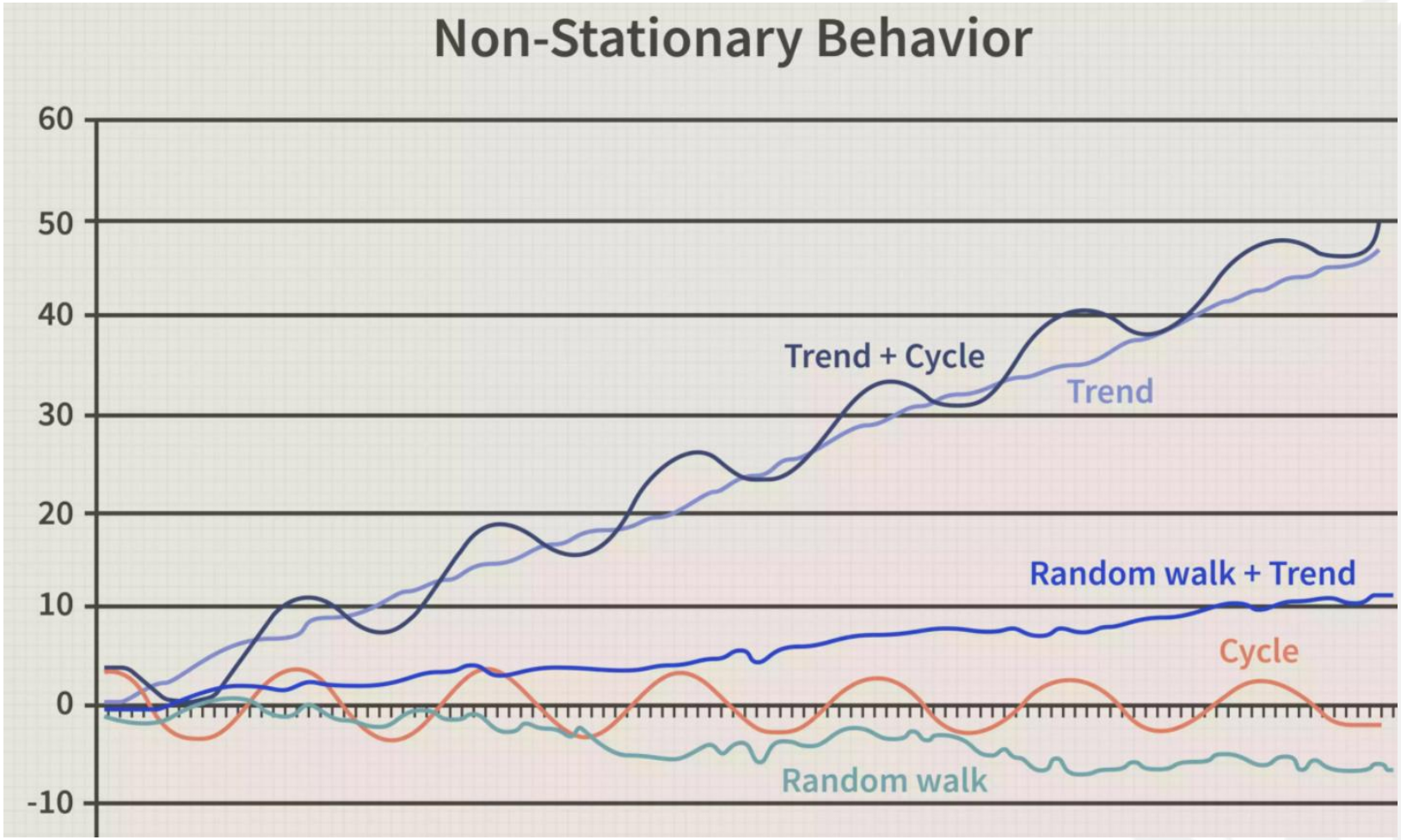
- Seasonality: **Seasonality** refers to **periodic fluctuations**. For example, electricity consumption is high during the day and low during night, or online sales increase during Christmas before slowing down again.



- **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



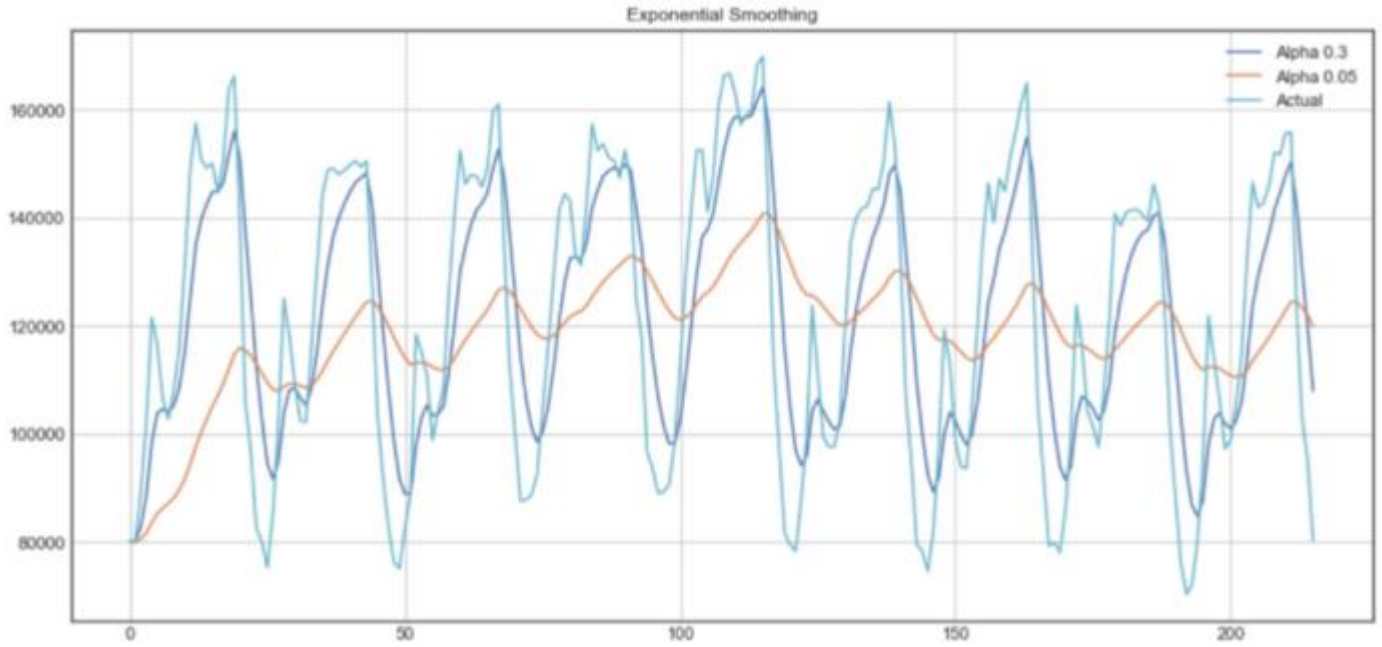
4. Complete guide

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

https://towardsdatascience.com/the-complete-guide-to-time-series-analysis-and-forecasting-70d476bfe775

4. Complete guide

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



- 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 ε_t is a white noise process with zero mean and constant variance σ_ε^2. (Note: The subscript on φ_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 μ, it follows from

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

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

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

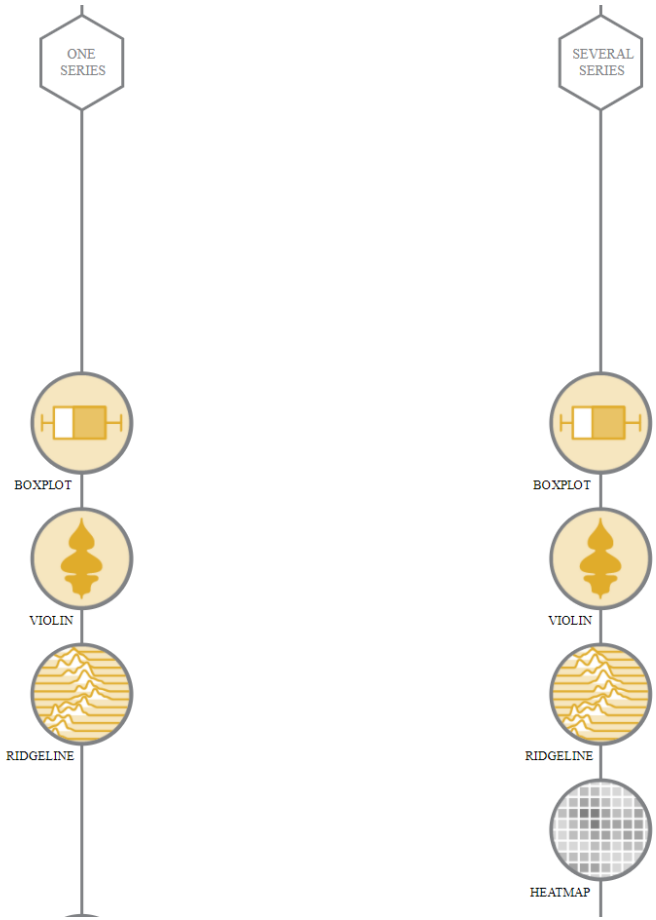
https://towardsdatascience.com/understanding-arima-time-series-modeling-d99cd11be3f8

4. Cheat Sheet

- https://machinelearningmastery.com/time-series-forecasting-methods-in-python-cheat-sheet/
- Podeu calcular noves sèries temporals de sèries ja existents i aplicar els mètodes a aquestes darreres

5. Gràfiques time series

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



Gràcies per la vostra col·laboració!

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