Time Series

Overview

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Time Series - definition

- Time series are data points **indexed in time order**.

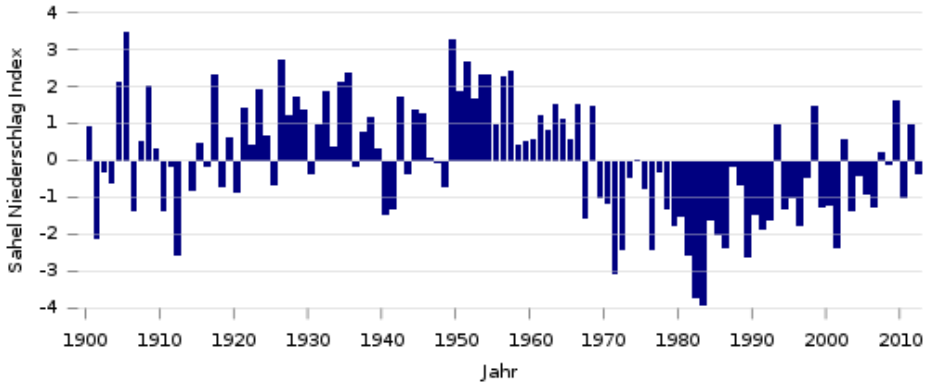
- Time series data is a collection of observations obtained through repeated measurements over time.

Time Series – examples

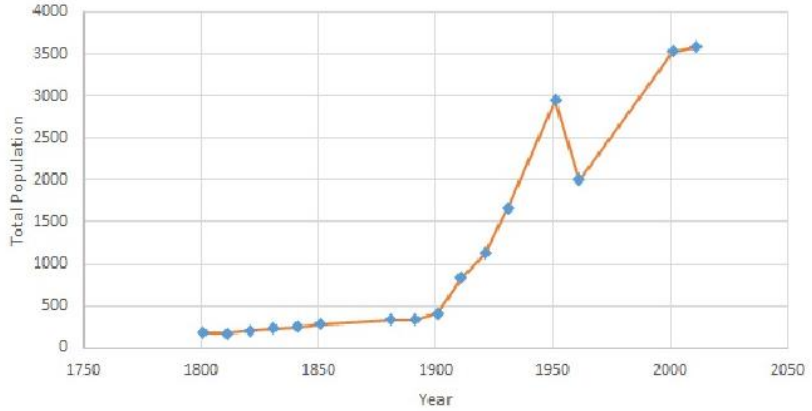
- Stock and shares price
- Sales, revenue
- Income through donations
- Energy demand & production
- Air quality (particle concentration)
- Temperature
- Ocean tides
- Electrocardiograms, encephalograms

Time Series – examples

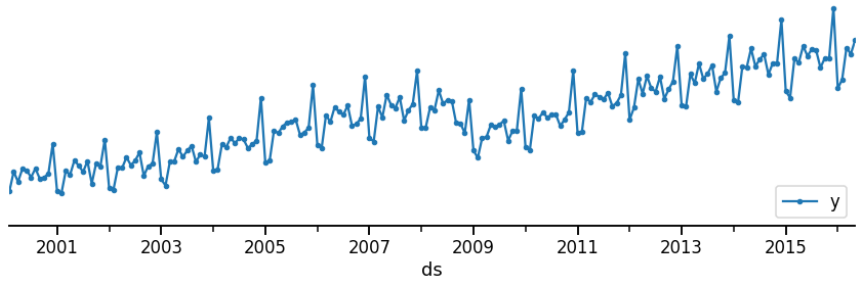
Rainfall



Population growth



Airline passenger traffic

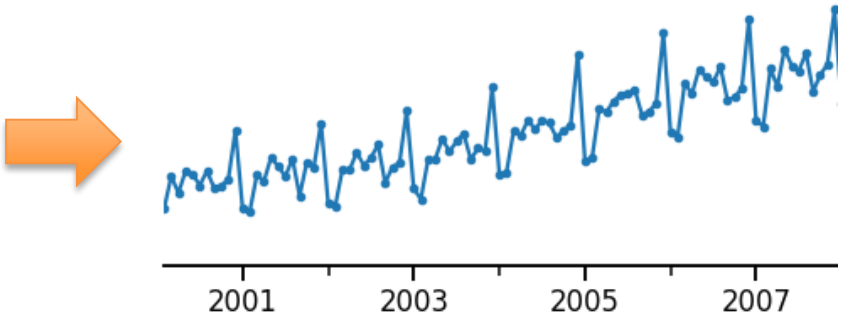


Electrocardiogram

Univariate Time Series

Time series have **values** and a **time index.**

Time	Sales
30/03/20	200
31/03/20	220
01/04/20	230
02/04/20	235



- Mean hourly temperature in London.
- Hourly energy demand in Buenos Aires.
- Weekly sales revenue in our family store.

Multiple Time Series

Wide format

	Sales revenue			
Time	**Item 1**	**Item 2**	**Item 3**	**Item 4**
30/03/20	200	100	330	120
31/03/20	220	120	300	135
01/04/20	230	150	335	133
02/04/20	235	175	340	200

- Sales revenue – multiple products
- Energy consumption – multiple households
- Temperature – multiple districts

Image taken from:

https://cienciadedatos.net/documentos/py44-multi-series-forecasting-skforecast.html

Multiple Time Series

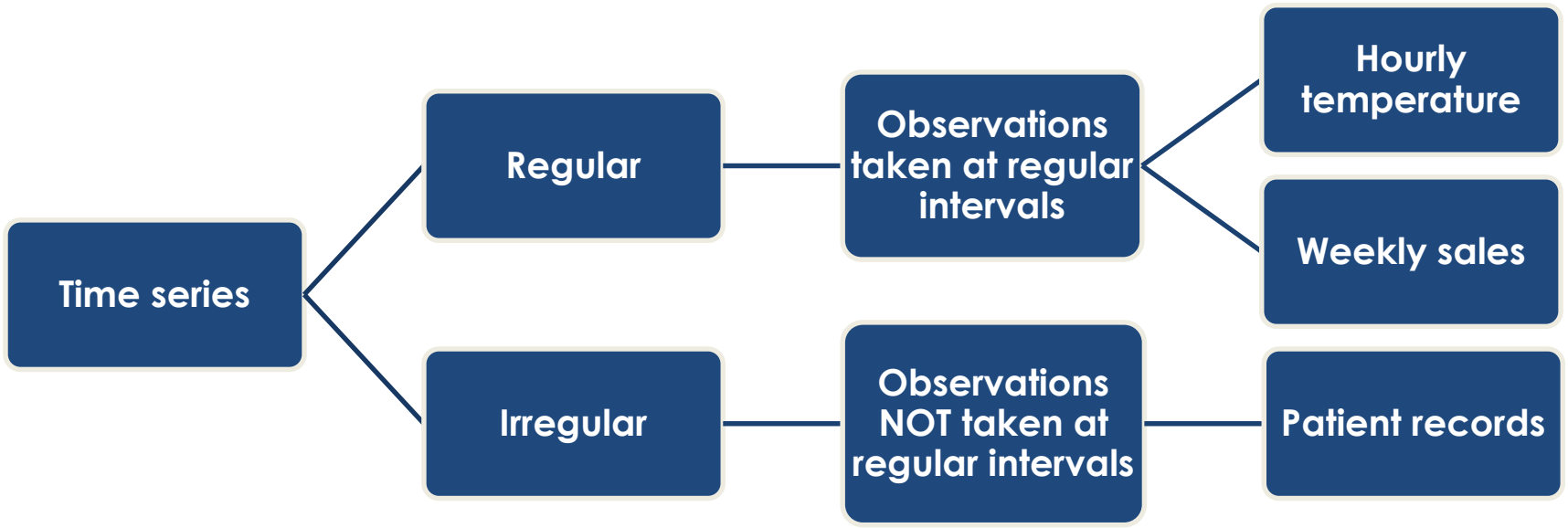
Long format

Time	Sales	Item
30/03/20	200	1
31/03/20	220	1
01/04/20	230	1
02/04/20	235	1
30/03/20	100	2
31/03/20	120	2
01/04/20	150	2
02/04/20	175	2
30/03/20	330	3
31/03/20	300	3
01/04/20	335	3
02/04/20	340	3

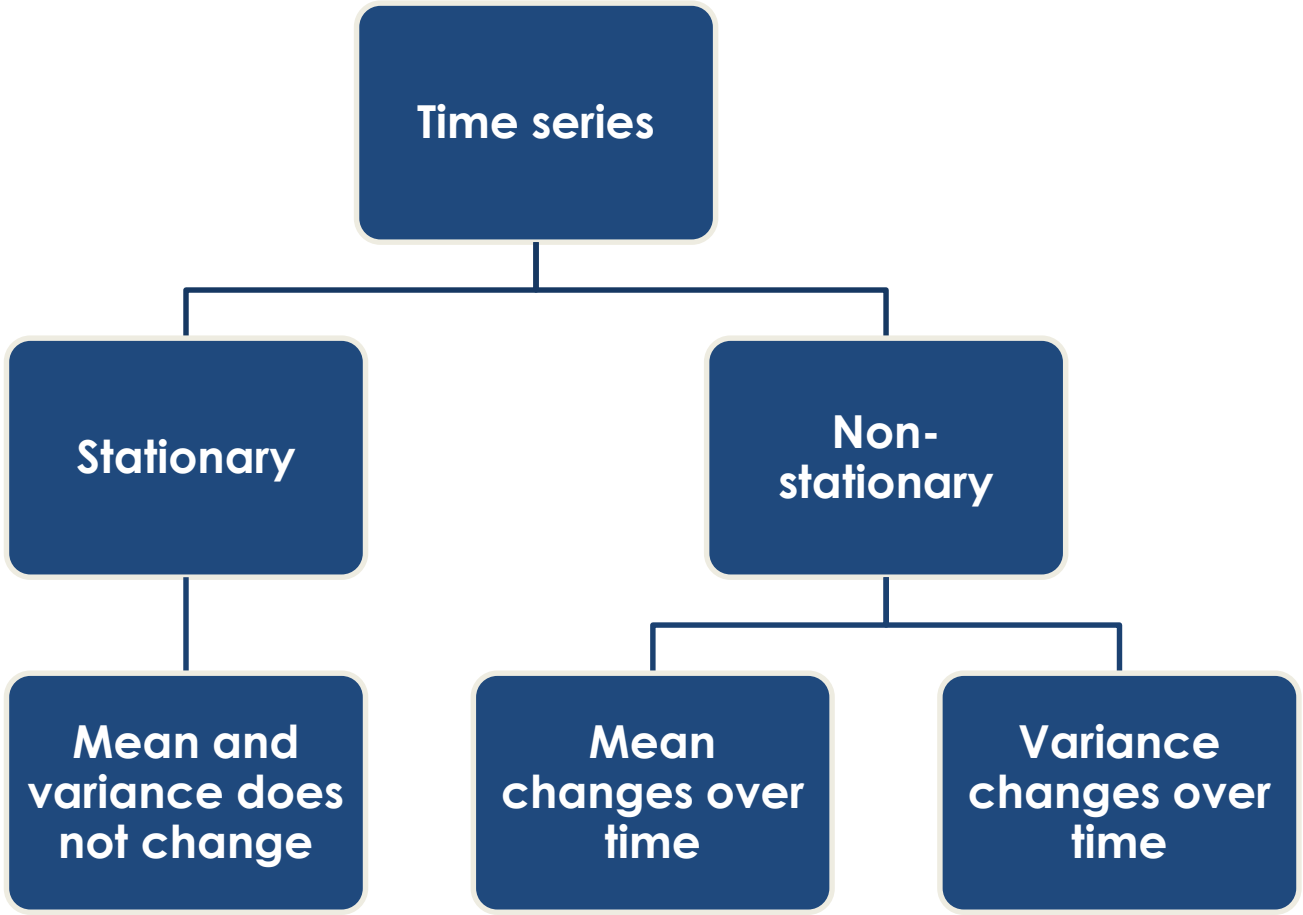
https://cienciadedatos.net/documentos/py44-multi-series-forecasting-skforecast.html

- Item is a time series ID
- Dates are not unique.

Time Series - types



Stationary vs Non-stationary

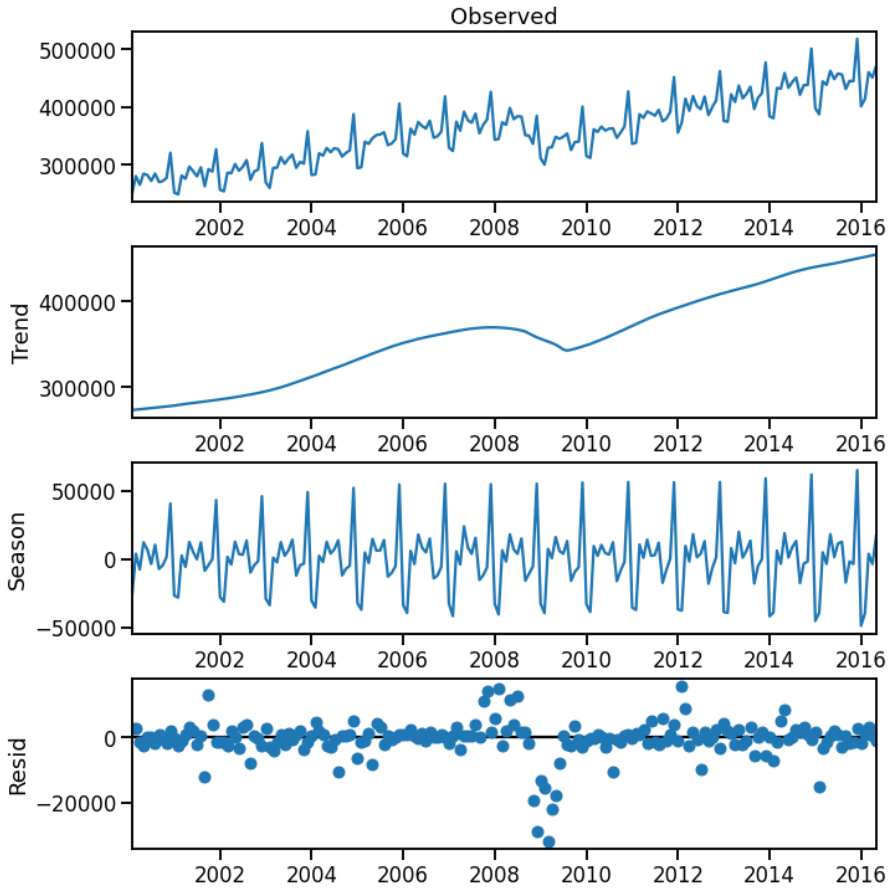


Most time series are non-stationary.

Time Series - components

- **Trend:** long term change in the mean of the time series.
- **Seasonality:** regular, repetitive fluctuations.
- **Cyclicity:** irregular fluctuations over longer time periods.
- **Residuals:** error term, irregular fluctuations.

Decomposition is not always possible.



Summary

- Time series are data points indexed in time order.
- Time series can be regular or irregular.
- Time series can be stationary, or more commonly, non-stationary.
- Time series can be decomposed into defined components.