Alberto Andrés Valdés González.
Degree: Mathematical Engineer.
Work position: Data Scientist.
Mail: anvaldes@uc.cl/alberto.valdes.gonzalez.96@gmail.com
Location: Santiago, Chile.

Types of Time Series

First of all we have to define what is a Time Series.

Time Series: A Time Series is a sequence of random variables $\{X_t\}$ with temporal dependency (order matters).

Example: It's not the same the next 2 time series of the temperature:

Sequence $1 : 10, 15, 20$

Sequence $2 : 20, 15, 10$

Types of Time Series

There is two types of Time Series: Stationary and Non Stationary.

Definition: Let be $\{X_t\}$ a time series with $\mathbb{E}[X_t^2] < \infty$. The mean of X_t is given by:

$$\boxed{\mu_X(t) = \mathbb{E}[X_t]}$$

And the covariance is defined by:

$$\boxed{Cov(X_r, X_s) = \gamma_X(r, s) = \mathbb{E}\left[(X_r - \mu_X(r)) \cdot (X_s - \mu_X(s))\right]}$$

Definition: A time series $\{X_t\}$ is stationary in the second order sense if:

(I) $\mu_X(t)$ is independent of t.

(II) $\gamma_X(t, t+k)$ is independent of t for all integer k.

Definition: A time series $\{X_t\}$ is strictly stationary if the random vectors $(X_1, ..., X_n)$ and $(X_k, ..., X_{(n+k)})$ have the same distribution for all integer k and $n > 0$.

Strictly stationary $\Rightarrow$ 2nd order stationary

Among the Non Stationary Time Series are the dependent of endogenous variables (Airpassengers) and dependent of exogenous variables (Market Actions).