TIME SERIES ANALYSIS LECTURE 1

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Stationarity: Example 1

1. White Noise

White Noise Recall that a *white noise* process, w_t is a sequence of random variables indexed by t, that are *independently* and *identically distributed* with mean zero and variance σ_w^2. Therefore, the process's first two moments can be written as

$$\begin{aligned} E(w_t) &= \mu_w \\ &= 0 \end{aligned}$$

$$\gamma_k = Cov(w_t, w_{t+k}) = \begin{cases} \sigma_w^2 & \text{if } k = 0 \\ 0 & \text{if } k \neq 0 \end{cases}$$

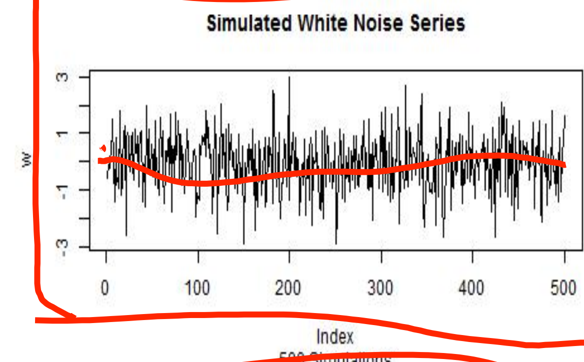
and the corresponding autocorrelation function is

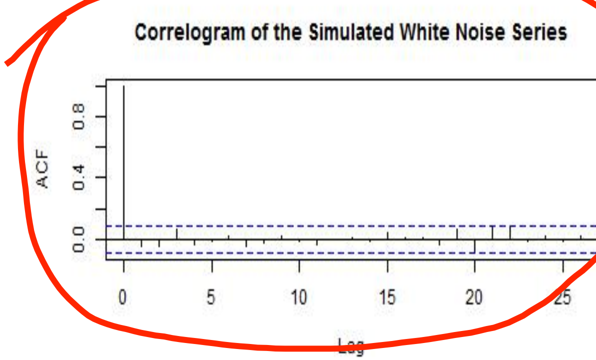
$$\rho_k = \begin{cases} 1 & \text{if } k = 0 \\ 0 & \text{if } k \neq 0 \end{cases}$$

1. White Noise: Simulations

A time series $\{w_t : t = 1, 2, \ldots, n\}$ is *discrete white noise* (DWN) if the variables $w_1, w_2, \ldots, w_n$ are *independent* and *identically* distributed with a mean of zero. This implies that the variables all have the same variance σ^2 and $\mathrm{Cor}(w_i, w_j) = 0$ for all $i \neq j$. If, in addition, the variables also follow a normal distribution (i.e., $w_t \sim \mathrm{N}(0, \sigma^2)$) the series is called *Gaussian* white noise.

- Not surprisingly, the simulated series appears random, and its autocorrelation function (acf) shows no statistical significant correlation with any lags.
- The blue dotted lines represent the 95% confidence interval of the autocorrelation.
- Keep these patterns in mind because we will be comparing estimated residual series (in later lectures) and examine if they resemble the dynamics of white noise.





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