Vaibhav Rastogi

Summary

ACF and PACF are vital statistical tools in time series analysis used to

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ACF and PACF

Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) are crucial tools in time series analysis, particularly in the identification of models like ARIMA. They provide insights into the correlation structure of a time series, helping determine the order of autoregressive and moving average components.

Autocorrelation Function (ACF):

The Autocorrelation Function describes the correlation between observations of a time series at two points in time, separated by a specific lag k.

previous values. The ACF is given by:

$$\rho_k = \frac{\sum_{t=k+1}^{n}(Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^{n}(Y_t - \bar{Y})^2}$$

where:

- ρ_k — Autocorrelation at lag k

Insights from ACF:

- A slow decay in the ACF may suggest an autoregressive (AR) component.

- A sharp cut-off in the ACF might indicate a moving average (MA) process.

Partial Autocorrelation Function (PACF):

While the ACF measures the correlation between two points with a given lag, it doesn't account for the influence of other intervening observations. The PACF remedies this by measuring the correlation between two points, controlling for the values at all shorter lags.

after accounting for the correlations at shorter lags 1,2,...,k-1.

Insights from PACF:

- A sharp cut-off in the PACF after a lag p might suggest an AR(p) component.

- A slow decay in the PACF may indicate an MA component.

How to Use ACF and PACF:

The ACF and PACF are typically visualized using correlograms, where the x-axis represents the lag and the y-axis represents the correlation value. Horizontal lines on the plot indicate statistical significance levels, helping identify which lags have significant autocorrelation.

Example Usage:

- If you observe a sharp cut-off at lag p in the PACF and a gradual decay in the ACF, it might suggest an AR(p) model.

- If you see a sharp cut-off at lag q in the ACF and a gradual decay in the PACF, it might suggest an MA(q) model.

Conclusion:

components in time series modeling, like ARIMA. They provide insights into the internal correlation structure of the time series data, guiding model selection, and interpretation. Many statistical software packages (e.g., R, Python) provide functions to easily compute and plot the ACF and PACF.

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