GARCH models

GARCH (Generalized Autoregressive Conditional Heteroskedasticity) models are a class of time series models used to model and forecast volatility in financial markets. They are often used to model the volatility of stock prices, exchange rates, and other financial instruments. GARCH models are an extension of ARCH (Autoregressive Conditional Heteroskedasticity) models and include both the autoregressive component and the moving average component. The GARCH model is specified as: σ^2t = ω + α \* y^2(t-1) + β \* σ^2(t-1)

where σ^2t is the conditional variance at time t, y^2(t-1) is the squared residual of the previous time period, and ω, α, and β are parameters to be estimated.

GARCH vs ARIMA vs SARIMA

GARCH, ARIMA, and SARIMA are all time series models, but they are used for different purposes.

ARIMA (AutoRegressive Integrated Moving Average) models are used to model and forecast time series data that has a clear trend and/or seasonality. An ARIMA model includes both autoregressive (AR) and moving average (MA) components, and can also include a differencing component (I) to make the time series stationary. The notation for an ARIMA model is ARIMA(p,d,q), where p is the order of the AR component, d is the order of differencing, and q is the order of the MA component.

SARIMA (Seasonal AutoRegressive Integrated Moving Average) is an extension of ARIMA that includes a seasonal component. It is used for time series data that has both trend and seasonality. The notation for a SARIMA model is SARIMA(p,d,q)(P,D,Q)m, where m is the number of seasons.

GARCH, on the other hand, is used to model and forecast the volatility of a time series, rather than the mean. GARCH models are used to model financial time series data, such as stock prices or exchange rates, that exhibit volatility clustering, which means that the volatility of the series is not constant over time.

In summary, ARIMA and SARIMA are used for modeling and forecasting the mean of a time series, while GARCH is used for modeling and forecasting volatility of a time series.

What is volatility

Volatility is a statistical measure of the dispersion of returns for a given security or market index. It represents the level of variation of a financial instrument's price over time. In other words, it measures how much the price of a stock, commodity or any other financial instrument fluctuates. High volatility means that the price of a security can change dramatically over a short time period, while low volatility means that the price does not fluctuate as much. Volatility can be measured using various methods, such as the standard deviation of returns or the average true range.

Volatility is an important factor in the financial markets, as it affects the pricing of financial derivatives, the value of portfolios and the cost of capital. High volatility can lead to large losses, while low volatility can lead to missed opportunities. Volatility is also used to gauge the level of risk associated with a particular investment.

heteroskedasticity

Heteroskedasticity is a statistical term used to describe the situation where the variance of the errors in a time series model is not constant over time. In other words, it refers to a non-constant variability of the residuals of a model. This means that the model's errors exhibit a pattern, where the variance of the errors is different for different values of the predictor variables. Heteroskedasticity can lead to biased and inefficient parameter estimates and can affect the validity of statistical tests.

When heteroskedasticity is present, standard errors and confidence intervals will be too small, leading to over-optimistic inferences. The problem of heteroskedasticity can be addressed by using techniques such as weighted least squares, or by applying a transformation to the data such as taking the log of the dependent variable.

ARCH (Autoregressive Conditional Heteroskedasticity) and GARCH (Generalized Autoregressive Conditional Heteroskedasticity) models are specifically designed to model and forecast volatility in financial markets, where heteroskedasticity is often present.

Volatility clustering

Volatility clustering refers to the phenomenon where volatility in financial markets tends to persist over time. In other words, periods of high volatility tend to be followed by other periods of high volatility, and periods of low volatility tend to be followed by other periods of low volatility. This is also known as a volatility persistence or volatility autocorrelation.

The volatility clustering is a well-documented phenomenon in financial markets, and it has been observed in a wide range of financial instruments, such as stocks, bonds, commodities, and currencies. The reason for volatility clustering is not fully understood, but several theories have been proposed, such as the presence of feedback loops, the impact of news and events, or the influence of investor's behavior.

Modeling volatility clustering is an important task in finance, as it allows for more accurate forecasting of volatility and better risk management. GARCH (Generalized Autoregressive Conditional Heteroskedasticity) models are commonly used to model volatility clustering, as they allow for the modeling of the time-varying volatility of financial time series.

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