Historical Volatility

Historical Volatility reflects the past price movements of the underlying asset, while implied volatility is a measure of market expectations regarding the asset's future volatility. Historical volatility is also referred to as the asset's actual or realized volatility. There are different ways of measuring historical volatility. We use so called close-to-close volatility.

Historical close-to-close volatility (HV) is annualized standard deviation for close stock prices returns observed on a given time period – N days.
At present we calculate for all IVolatility stocks HV of terms:
10, 20, 30, 60, 90, 120, 150, 180 days

Formulas

N – period of observation
Pt – close price of t day
t: from 1 to N+1

Return $x_t = \text{Ln}\,(P_t / P_{t-1})$

$$X(\text{mean of } x_t) := \frac{1}{n}\sum_{1}^{n} x_t$$

$$HV_{daily} = \sqrt{\frac{1}{(n-1)} * \sum_{1}^{n} (x_t - X)^2}$$

$$HV(1year) = HV_{current} * \sqrt{252}$$

Implied Volatility (IV)

Implied Volatility of a stock or an index is computed using an option pricing model such as the Black-Scholes or Binomial. In contrast to historical volatility, which is a measure of price changes in the past, Implied Volatility reflects expectations regarding the stock or market's future volatility. It can also help to gauge whether options are cheap or expensive. Rising implied volatility causes option prices to rise or become more expensive; falling implied volatility results in lower option premiums. Therefore, with everything else being equal, when implied volatility on an option is high, it is better to sell that option; If the implied volatility is low, the option more suitable for buying.

To solve for implied volatility, option pricing models require:

- the option's expiration date
- the strike price of the option
- the price of the underlying asset
- the dividends paid
- the prevailing interest rate
- the current option's price
- style of options
- call/put

We use

- For all European style options and American style ‘Calls’ without dividends – Black-Scholes model
- Other cases – Binomial model, 100 steps

Implied Volatility Index (IV Index)

The Implied Volatility of a stock or index is Volatility implied by an option price observed in the market. Because there are many options on a stock with different strike prices and expiration dates, each option can yield a different volatility implicit in an option's premium. Even options with the same number of days remaining until expiration, but with different strike prices, will have different values of implied volatility. Thus to use implied volatility in volatility analysis, it is necessary to calculate a representative implied volatility for a stock. There are many ways to calculate such a type of representative value. It can be calculated as average implied volatility of the at-the-money options only or at-the-money and out-the-money options etc.

We calculate such a composite Volatility for a stock by taking suitable weighted individual option volatilities. This composite volatility will be referred to as the Implied Volatility Index.

The Implied Volatility Index is calculated by using a proprietary weighting technique factoring the delta and vega of each option participating in IV Index calculations. In total, we use 4 ATM options within each expiration to solve for the Implied Volatility Index of each stock. This IV Index is normalized to fixed tenors (30, 60, 90, 120, 150, 180 days) using a linear interpolation by the squared root of time.

IVIndexCall and IVIndexPut are the implied volatility indexes calculated for only calls or puts. IVIndexMean is calculated as an average between IVIndexCall and IVIndexPut. IVIndexMean is nothing other than the Implied Volatility Index.

The IVIndex forecasts a stock's Volatility for 1, 2, 3, 4, 5, or 6 months. At the same time, its value represents how expensive or cheap options are in each fixed maturity. Compared with implied volatilities of an individual out-the-money or in-the-money option, the IV

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Index indicates how expensive the option is in relation to the at-the-money options. The IV Index of major market indices is one of the many tools of sentiment analysis, i.e. studying the prevailing market psychology.

For any calculation date (lets call it DateX) IV Index Term T is interpolated on the basis of a set of option contracts with expirations dates Date1 and Date2 such that:

Date1 < DateX + T < Date2

For those 2 dates we calculate IV Index (on the basis of 'good' IV For Index and corresponding Vegas) as:

$$IVIndex\,(Date1) = \left(\sum_{i=1}^{4} vega\left(Strike_i, Date1\right) * IVforIndex\,(Strike_i, Date1) \right) / \sum_{i=1}^{4} vega\left(Strike_i, Date1\right)$$

$$IVIndex\,(Date2) = \left(\sum_{i=1}^{4} vega\left(Strike_i, Date2\right) * IVforIndex\,(Strike_i, Date2) \right) / \sum_{i=1}^{4} vega\left(Strike_i, Date2\right)$$

Further interpolation for IV Index Term T:

$$IVIndex\,(T) = IVIndex\,(Date1) + (IVIndex\,(Date2) - IVIndex\,(Date1)) * \frac{\sqrt{T} - \sqrt{T1}}{\sqrt{T2} - \sqrt{T1}}$$

where T1 and T2 is number of days between (DateX and Date1) and (Date2 and dateX) respectively and both IV Indexes <> -1