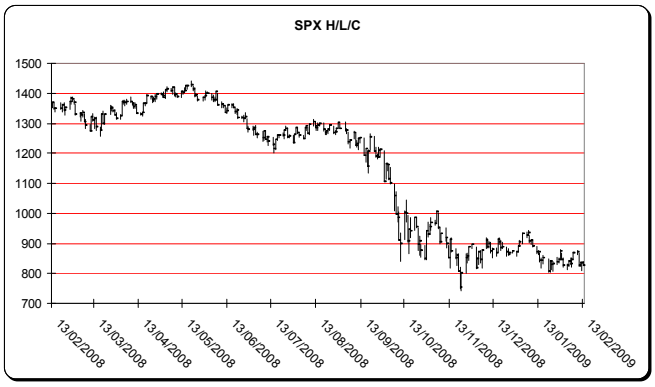
20.4.9 Application of "Historical" Methods to Real World Options Pricing

The image to the right shows the OHLC history for SPX over the year 2008. This history and some subsets will be used for a number of examples and discussions of the various historical measures above.



Before considering of the "multi vols" (i.e. HL, HLC, OHLC, etc.) it is crucial to understand that "single point vols" (e.g. Close – Close) already have much in the way of "decisions" or "interpretations".

HVol-C
42.135%
HVol-H
29.240%
HVol-L
37.775%
HVol-O
39.949%

The Table to the right shows the standard "single point" historical vol when applied via the standard Close – Close convention to the entire year's Closes (i.e. via Equation (20.35)), and also the Open – Open, High – High, and Low – Low equivalents. The aqua shading is used to emphasise that those variations are not the "standard" versions. It is immediately striking that the range of values of 29.240% - 42.135% covers a very large range of "possible" vols. Use the accompanying software to price an option with the vols at these extremes to see the impact on pricing. Clearly, for almost all trading, this type of range of values is much too great an impact on P&L and risk management to be useful without further consideration.

The market convention (when historicals are used) is to rely on Closes based version, with the "argument" that so long as it is used consistently, then on-average it should be "OK". There is also the argument that Closes are generally the result of special attention as they are used for M2M and settlement purposes. These are not very convincing arguments for traders who have to rebalance on the "realised" variations. This also demonstrates the usual weakness of historical methods in that there are "choices" for specifying the "ultimate" calculation/definition, but not much "science" to assist with those choices.

One observation already at this point is that Closes and Opens based vols appear to be higher compared intra-day (i.e. HL and similar) measures. This point is discussed further below, but you might have already guessed that the "gaps" betweens Opens and Closes may have a greater vol contribution compared to daily HL ranges over some periods. To provide an initial indication of this, suppose the C-C vol was calculated based on yesterday's C, but today's O (instead of today's C). This is not a "proper return", since it implies "zero days on deposit", still it shows an element of the volatility. Now, the vol

would be 4.57%. That is, the contribution of the "direct gap" from yesterday to today in the vols is around 5% of vol (i.e. around 15-20% of the vols) for this particular history/period.

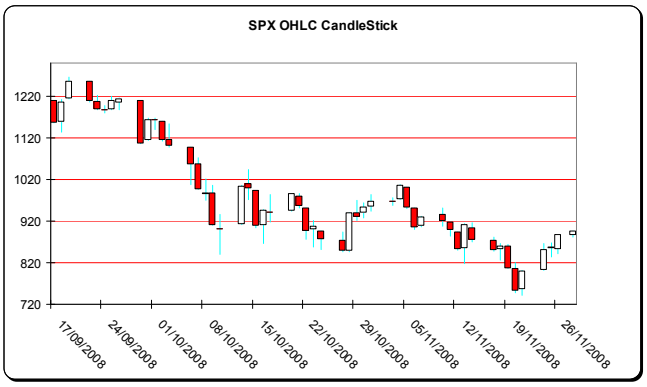
However, if the calculation is "inverted" by using yesterday's O and today's C, then the usual "single point" formulation results with a vol of 53.29%, very much greater compared to any of the other vols. This too is "not a proper return vol" since it implies "two days on deposit". Nevertheless, this and the previous "OC" vols illustrate that inter- and intra-day effects each contribute significantly to the historical measure.

The Table below shows the historical vols based the formulations above. An extra value labelled "**Excel**" is provided as a verification to show that Excel's® **StDev()** intrinsic function produces the identical vol when applied to history of Closes based returns derived from the prices, as does the explicit historical vol formula; as it should.

Excel	HVol-C	HVol-HL	HVol-HLC	HVol-OHLC(S)	HVol-OHLC(N)
42.135%	42.135%	33.822%	30.071%	31.077%	31.467%

The Closes based vol is still the highest, with the "multi-point" vols being generally lower. That they are lower is not necessarily "lower actual vol", but rather to some extent the result that the "single point CC vol" in this example is relatively high (e.g. had, say, HH been chosen for the "single point vol", then the "multi-point" vols would have been higher). This type of asymmetry occurs in part when markets are trending. In addition, some of the "multi-point" vols are "(S)ame day" vols (i.e. price data reflecting changes only today), while others are "(N)ext day" vols (i.e. have contributions from yesterday and today).

Finally, these formulations assume one particular choice of weighting of the individual contribution of intra-day ranges vs. inter-day ranges. The image to right shows a short segment of the data history, covering the months straddling the "08 crash". This is an "OHLC Candlestick" chart, with the following construction definitions:



Down Bar	if Open < Prev Close
Up Bar	if Open > Prev Close
High-Low	HL range for the day

Thus, the red and white boxes show the C – O gaps, with red used for down gaps, and white for up gaps. The aqua lines are the daily HL ranges. The black "ticks" are the C's.

Clearly, there are days when the gaps dominate the vol (red/white), while on other days the HL range is dominant (aqua). This is a slightly unusual range in that the scale of the