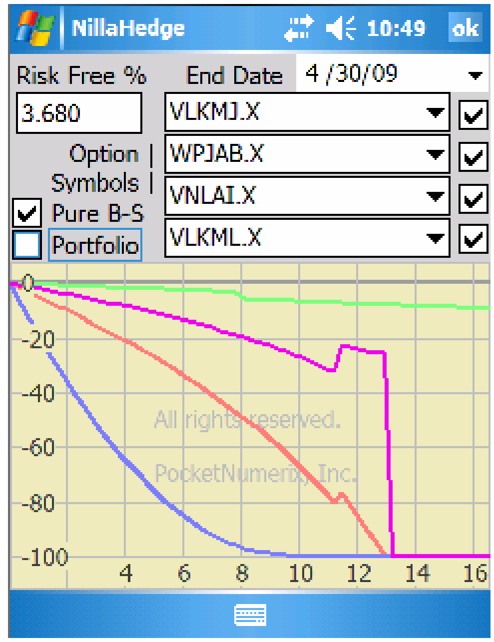
Time Decay Explorer



The Time Decay Explorer provides a graphical view of the relative rate with which option values decay as time passes. Options exhibit a variety of decay behaviors, from near linear (WPJAB.X in green) and smooth decay (WNLAI.X in blue) to a cliff-like drop (VLKML.X in purple) on the expiration date. The discontinuities in the green, purple, and red curves occur at the respective underlying stock's ex-dividend dates. 'Today' in the plot at right is December 14, 2007.

A call exercised before an ex-dividend date gives the option holder the right to the dividend on the underlying stock. Waiting to exercise until after the ex-divdend date leaves the right to the dividend with the current stockholder of record, so the call loses value on that date. Applied Materials (AMAT) has an ex-dividend date on August 14, so WPJAB.X, a Jan-2010 call on AMAT in green, loses value on that date. Conversely, put options gain value when an ex-dividend date passes. Kellogg (K) has an ex-dividend date on November 15, so VLKMJ.X, a Jan-2009 put on Kellogg in red, gains value on that date. Ditto for VLKML.X, a Jan-2009 put on Kellog in purple.

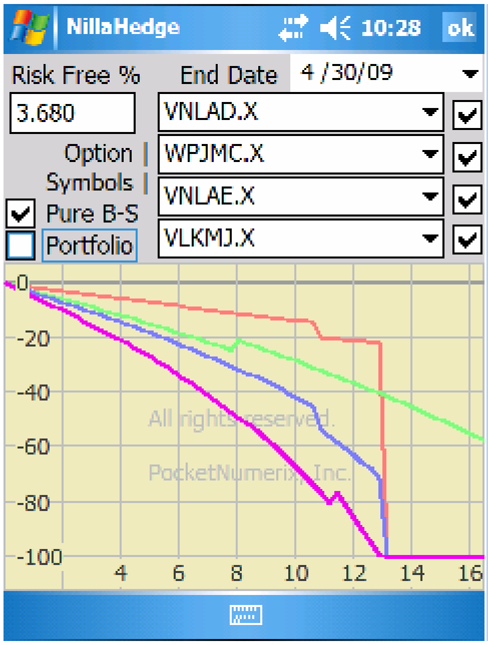
The Time Decay Explorer uses the most accurate approach available for computing Black-Scholes value and consequently is by far the most computationnally intensive analysis in NillaHedge. That computational complexity derives from the need to compute the present value of each potential dividend from the present day to the specified End Date. That may be as many as four dividends per year per issue in the portfolio, at each point in time depicted on the plot (which may span multiple years resulting in as many instances of each quarterly dividend).

The walk away consideration is that a multi-year plot of a portfolio containing many options drawn upon stocks with multiple dividends may post a wait cursor for much longer than you are accustomed to elsewhere in NillaHedge. The good news is that given the computational investment in the portfolio plot, its points are only computed once when the dialog is posted (if the Portfolio button was checked the last time you used it) or upon checking the portfolio box (if it wasn't checked the last time you used it). Thus, subsequent changes in the selected (red, green, blue, and purple) options will plot relatively quickly. As your options portfolio grows, you will undoubtedly find it increasingly useful to disable the portfolio plot before closing the dialog, so the next time that the Time Decay Explorer posts, the decision to plot the portfolio will be yours.

The Plot

Time-decay plots depict time in months along the X-axis and percent change in option value along the Y-axis.

The colors assigned to option symbols are red, green, blue, and purple ordered from the topmost symbol to the bottom (e.g. VLKMJ.X – red, WPJAB.X – green, etc.). When option positions exist in the database, the Portfolio checkbox will be enabled, as it is here.



As you can see, time-decay curves can be discontinuous, even exhibiting sharp vertical drops. The compromise between accuracy and responsiveness produces diagonal lines that would be perfectly vertical, given infinite computing capacity. The options and portfolio are not evaluated at every single visible point, but at discrete intervals across the X-axis. One pixel of horizontal displacement is unavoidable, so a curve that would appear as a nearly perfect vertical drop if all the points were plotted will appear to have a very sharp slope instead. Such approximations to the vertical impute no information whatsoever about the value of the issue or portfolio at intervening X-values; the Y-values at the rightmost point of the segment on top of the cliff and at the leftmost point of the segment below the cliff are accurate, but in between nothing whatsoever has been computed, the curve is merely an instrument of visual continuity. You'll note that more than one pixel of deviation is evidenced in the plots on this page. At present, the the selected options and the options portfolio (if it is enabled) are plotted at sixty points in time, or about once every six days for a plot spanning one year. On a QVGA (240x320 pixel) screen, that's one evaluation for every four horizontal pixels, resulting in three unknown points between the ideally vertical segments.

Risk Free Rate

The Risk Free Rate edit box displays the currently stored value for the risk free rate. It's expressed as a percentage with a default value of 3%.

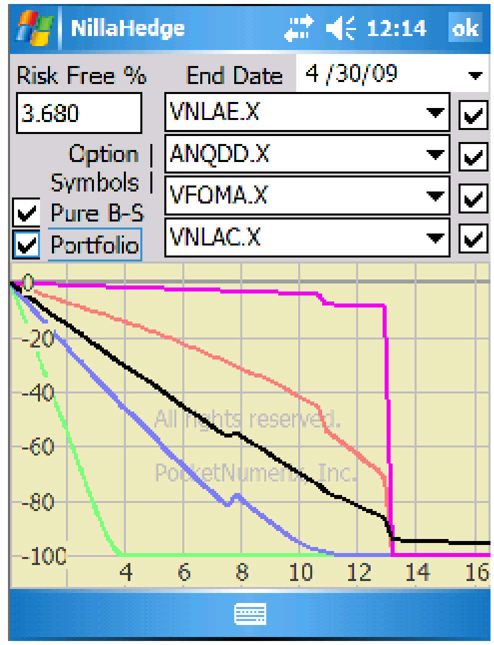
End Date

The End Date picker defaults to twelve months from the current date, but can be set earlier or later to zoom the X-axis in or out, respectively. A 'practical' range of two months to four years from the current date is enforced. The EndDate of each these plots was extended beyond the twelve month default to a bit over sixteen months, to capture ex-dividend dates and the expiration of January 2009 options.

Plot Enabling Checkboxes

The checkboxes on the right side of the dialog enable/disable plotting the time-decay of the option symbol immediately at its left.

Portfolio



The Portfolio check box enables you to see how your entire option portfolio responds to the passage of time. The Time Decay Explorer plots a polyline which sums all option positions in your portfolio using each option's cost-weighted contribution to the portfolio.

The plot at right was drawn on 14-Dec-07. VNLAC.X (purple) is a Jan-09 call on Intel, with Intel paying $0.45 to the shareholder of record on November 3. VNLAE.X (red) is a Jan-09 put on Intel Corp. (INTC). VFOMA.X (blue) is a Jan-09 call on Ford Motor Co. (F), set up with Ford paying a $0.20 on July 31. ANQDD.X is an April-09 call Applied Materials (AMAT), with Applied Materials paying $0.24 to the shareholder of record on August 14.

Obviously, it doesn't take a lot of positions in the portfolio for the ups and downs associated with ex-dividend dates and option expiration dates to render various discontinuities in the portfolio plot. In this example, the portfolio consists of 100 of WPJMC.X, 100 of VNLAE.X, 100 of VLKMJ.X, and 1100 of VFOMA.X. Note that the rise in portfolio value associated with 1100 VFOMA.X put options at Ford's ex-dividend date (around 8 months from 'today') is subtler than the expiration of 200 options (VNLAE.X and VLKMJ.X) in January 2009 (around 13 months from 'today'). The August 2008 (just over 11 months from 'today') ex-dividend rise due to 100 VLKMJ.X puts on Kellogg is barely noticeable.

Pure Black-Scholes mode

Y-values on the plot represent percentages of the option's reference value, given by $100 \cdot \frac{bsv - rv}{rv}$, where *bsv* represents the Black-Scholes value at a given point in time and *rv* is a reference value which can be either the Black-Scholes value on the current date or the option's currently stored market price, based on the state of the Pure B-S checkbox. When Pure B-S is checked, *rv* is the option's reference value; when it's unchecked, the stored market price is used for *rv*.

The first screenshot (previous page) shows a Pure B-S mode plot. You'll note that all options start at time zero with a 0% displacement from the reference value and ultimately finish at -100% of the reference value.

In market price mode (Pure B-S is unchecked) the 'curves' may start above or below 0% but they'll all finish at -100% since $100 \cdot \frac{bsv - rv}{rv} \to -100$ as $bsv \to 0$. Options whose currently stored market price exceeds the current Black-Scholes value will start off showing a 'loss' (below 0%); options whose initial Black-Scholes value exceeds the currently stored market price will start off with a 'profit' (above 0%). Either way, the option or portfolio will decay in value from that initial point. All options for a given underlying stock are evaluated using the stock's currently stored price, volatility, and dividends. Since option value increases with volatility, if the stored volatility is close to the implied volatilities for the near-the-money options, the far-from-the-money options will appear undervalued (therefore starting off with a 'loss' as VPJMB.X does here) and vice-versa. If the stock pays dividends and you have not entered any in the stock definition, the market will undoubtedly have a different opinion about option value than you will compute in their absence.

In the example at right, note that the green (WFOMC.X) and purple (FMC.X) options actually increase in value over time when viewed in market price mode (Pure-BS unchecked). This could be something to get excited about because it means the current market price is below what an efficient market would normally assess, i.e. there's unrealized value within. However, in this case, the results were due to accepting the default values for dividends (0.00) and volatility (0.3), when in fact the defaults will frequently need refinement, i.e. garbage in will invariably produce garbage out. If you run into a situation like WFOMC.X or FMC.X after you've verified that the underlying stock's market price and dividends are correct and enabled in the Stock Definition, and your opinion on volatility is right where you want it to be, then a little excitement may be warranted.

Going Ex-Dividend

When ex-dividend dates loom near, it's possible that calls will begin to sell at a discount. Likewise puts may begin to incorporate a pro-forma ex-dividend premium. There is currently no broadly accepted analytical model that accounts for market premiums and discounts associated with nearby ex-dividend dates. In all likelihood changes in option value are somewhat less precipitous than an ideal present value treatment (used here) would indicate.

Volatility Premiums

Options obviously decay in value over time - some gradually, others abruptly. It therefore behooves you to be aware of how your options portfolio behaves so you won't be caught unaware when a precipitous change in value is imminent. Secondarily, switching between Pure B-S and market price mode can shed light on disparities between theoretical and market value. In the plot above, VPJMB.X appears to have a market price with a significant premium over its theoretical value. Similarly, VFOMU.X benefits from a large premium in the plot at right. How can market and theoretical values be so far off? Of course, the market could be temporarily out of sync or the contract writer might have unrealistic expectations, but (barring parameter error) more often than not you are witnessing the effect of the volatility smile.

Options with strikes distant from the current market price of the underlying stock (struck far from the money) have implied volatilities greater than those struck close to the market value. When you look at implied volatility vs. strike price, you generally find a convex curve with its low point near the stock's market price. The actual stock volatility is generally found at the low point. The portion of implied volatility beyond the stock's actual volatility is a reflection of increasingly bearish/bullish investor expectations, i.e. very bullish/bearish option investors believe that the stock's volatility is inherently higher in order to rationalize their market view. If you don't share their more dynamic view of the underlying stock's volatility, you are bound to run into option valuation disparities when analyzing options struck far from the money.

The VPJMB.X case will be discussed in more detail in the Volatility Value Explorer section on Volatility Risk, so we'll forego a detailed rationalization here. For now, it should be apparent that significant departures from a conservative implied volatility (computed near the current spot price on options with near term expiration dates) can have a dramatic (*non-linear*) influence on option value. Half of VPJMB.X's implied volatility in the example above is premium over a near term spot price assessment. The Volatility Value Explorer finds that volatility premium on AMAT effects a 15x change in VPJMB.X's theoretical value.