NillaHedge

User Guide

Version 1.0

Published by PocketNumerix, Inc.

Requests for permission or further information should be addressed to:

Mike Landis
PocketNumerix, Inc.

Table of Contents

Introduction

NillaHedge is a set of tools built on a common database that allows you to manage your stock and option holdings, analyze option issues, explore hedging strategies, and compare how interest rate changes affect option issues and your portfolio of option positions. Following is a brief introduction to the capabilities of this Pocket-PC application software, starting with an overview of the main menus.

NillaHedge is not a document-centric application, which means upon invocation all you'll see is the main menu and a blank screen. Switcher and similar utilities typically only include applications with open document windows in their list of running applications - the blank window gives Switcher something to find. If you don't have Switcher or it's equivalent, a tray icon will be available whenever NillaHedge is not the front most application.

The Menus

When you first open NillaHedge, you'll see the menu at right.

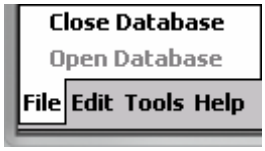
File Menu

NillaHedge uses a database to store instrument definitions and portfolio positions that you create while using it. All instrument definitions and portfolio positions created are immediately committed to the database, so there's no need to save at the end of a session. Just quit.

Open Database

Given the personal nature of Pocket-PCs, NillaHedge assumes that there is only one user and one database - it opens a database in a default directory upon invocation so you can get right to work. The only time you'll need to use Open Database is after you have previously closed the database. This menu item is only enabled when the database is currently closed.

Close Database



If you can't choose database directories, you might ask why include Open Database and Close Database at all? The answer is that ActiveSync won't sync open files and an open database will probably have several files open. Therefore, if you ever want your database backed up, you can use Close Database to close it manually and then reopen it after ActiveSync has finished. This menu item is only enabled when the database is currently open.

Edit Menu

The Edit menu is the entry point for creating and subsequently modifying instrument definitions and positions based on those definitions. Supported instruments include stocks and vanilla stock options (i.e. puts and calls). It also provides the entry point to the NillaHedge's two preferences dialogs. All Edit menu items are always enabled.

Stocks

The Stock Definition Dialog is a structured view of the data that defines a stock to the tools in NillaHedge, including its market price, volatility, and dividends.

Options

The Option Definition Dialog is a structured view of the data that defines a vanilla stock option to the tools in NillaHedge, including its market price, strike price, expiration date, underlying stock symbol, and whether it's a put or a call option.

Positions

The Positions dialog is your entry point for creating a position in a option or stock issue. It captures the purchase date, number of units in the position, and the cost of the position. It also captures a 'Note' field, allowing you to annotate a transaction number or a source of cash for the transaction, etc.

It also displays any positions previously created for the specified option or stock issue, including purchase date, number of shares or options, the original cost of the position, its current market value, the capital gain (loss), any dividend income that would have been generated since the purchase date, the net gain (capital gain plus income), the annualized yield that the net gain represents, and any note you may have entered when you created the position. If the underlying issue is an option, the income column is replaced by the exercise value of the options in the position.

Position List Options

If you read the previous section on the Positions dialog, you can see that there are quite a few columns of data computed for each position. To manage that complexity within the confines of a small screen, each of the columns in the Positions dialog's list of defined positions can be made invisible by un-checking the associated check box in the Position List Options dialog. The left column of preferences affects the display of columns in the Positions dialog while the right column of preferences affects the display of columns in the Portfolio Navigator.

Confirmation Options

The Confirmation Options Dialog controls behaviors spanning various dialogs. Two preferences affect behavior within definition dialogs (where you define a stock or an option issue), two affect behavior within the Option Analyzer dialog, two affect behaviors within the Positions dialog, and one affect behaviors within the Option Chain Retriever.[1]

[1] For details on the specific behaviors, refer to the section on the Confirmation Options Dialog.

Tools Menu

The Tools menu assembles a variety of tools in one place to accomplish a variety of tasks. One pulls option prices and other relevant information from the Internet, one is analytical, four are graphical, and two report the current state of your portfolio – one hierarchically, the other as a plain text transcript. Following is a brief introduction to each.

Option Chain Retriever

If you can access the internet from your Pocket-PC, the Option Chain Retriever will retrieve current prices, trading volume, and related information for options derived from a given exchange registered stock symbol. The Option Chain Retriever allows you to check current market prices, update the market price of existing option definitions, save new option definitions to the database, and update the market price of the stock underlying the option chain. This menu item is always enabled.

Option Analyzer

The Option Analyzer's primary purpose is to report Black-Scholes value, a half dozen Greeks, elasticity, implied volatility, and the probability of closing in the money. Of secondary importance is the ability to experiment with alternative values of the risk free rate and the underlying stock's volatility and market price to observe how such changes will affect the option's market value. This menu item will be disabled if there are no options defined in the database.

Hedge Explorer

The Hedge Explorer is a graphical tool displaying profit/loss curves for multi-issue positions consisting of up to three options on the same underlying stock, possibly including the stock itself. The Hedge Explorer supports ratio spreads and short positions and allows the user to modify the evaluation date, risk free rate, stock price and volatility. It displays the profit/loss curve for the constituent issues as well as the aggregate profitability. This menu item is disabled when there are no stocks or options defined in the database.

Rate Sensitivity Explorer

The Rate Sensitivity Explorer provides a graphical view of how the value of options and portfolios of options are affected by interest rate changes. This menu item is disabled when there are no options defined in the database.

Time Decay Explorer

The Time Decay Explorer is a graphical tool which plots option values versus time. It supports two modes of operation – one completely based on Black-Scholes value, the other incorporating the option's current market price. This menu item is disabled when there are no options defined in the database.

Volatility-Value Explorer

The Volatility-Value Explorer is a graphical tool which plots relative option value versus relative volatility of the underlying stock. Relative values are simply ratios of prospective volatility or option value divided by the currently stored value for the stock's volatility or the option's current Black-Scholes value, respectively. This menu item is disabled when there are no options defined in the database.

Portfolio Navigator

The Portfolio Navigator presents your current portfolio positions in a hierarchical explorer-like navigator, allowing you to drill down to the positions level within a particular stock or option, or abstract upwards in the tree until all you can see are column totals for the entire portfolio. Subtotals are provided at each level in the tree, i.e. the portfolio level, the instrument level (options or stocks), the issue level (particular stock and option issues), and the position level (issues you have a stake in). Background colors distinguish between row types to manage display complexity.[2] This menu item is disabled when there are no positions in the database.

Positions Transcripts

The Positions Transcripts dialog produces a detailed text transcript of all positions closed in a given year or currently open. It's the textual equivalent of a position level Portfolio Navigator display. It allows you to save the contents of the transcript to a file, thus providing convenient tax time documentation. This menu item is only enabled when there are positions in the database.

Help Menu

The Help Menu currently contains only 'About box' information about NillaHedge.

Common Behaviors

This section covers various considerations common across tools in NillaHedge, including the precision with which numbers are stored, slight variations from the Windows' standard behavior for combo-boxes, and an overview of database behavior and many behaviors common between the option and stock definition dialogs.

Floating Point Precision in the Database

Many of the edit boxes you'll encounter in NillaHedge dialogs await and/or display a numerical value. Most of these values are stored with floating point precision (23 magnitude bits in the mantissa and 7 magnitude bits in the exponent), producing the equivalent of 6.9 significant decimal digits. Examples of this level of floating point precision include interest rates, dividend amounts, market prices, and volatility.

[2] Options for column display in the Portfolio Navigator are set in the right hand column of Portfolio Navigator preferences in the Positions List Options dialog.

Number of shares or options in a position and the total cost of a position are all stored with double precision (52 magnitude bits in the mantissa and 10 magnitude bits in the exponent), producing the equivalent of 15.6 significant decimal digits. When either of these floating point representations is retrieved from the database and presented in a dialog control, it may be formatted with a fixed number of fractional digits, potentially truncating presentation of some of the significant digits. Be assured that the originally entered precision has not been truncated in the database, they're just not being displayed.

Combo-box variations

In the interest of minimizing pen taps, NillaHedge combo-boxes operate slightly differently from the Windows standard. Suppose you're using the drop-down portion of the combo-box and something in it is currently selected. If you tap somewhere in the dialog outside the drop-down box in a standard Windows application, it cancels the selection. By contrast, NillaHedge accepts the selection.

Instrument Definitions

It is useful to note that once saved, an instrument (stock or option) definition will be retained in the database forever, so it behooves you to limit the number of definitions you create to those that are actually meaningful. The storage occupied by an instrument definition is quite small, but NillaHedge thinks that each definition is equally significant, so the symbols for any junk definitions that may creep in will take up rows in the drop-down box when you're trying to locate a definition later.

Instrument definition dialogs have three things in common. Each one has a combo-box where you can type or select the unique symbol associated with the instrument definition, an edit box for the instruments' current market price, and an edit box labeled 'Description' whose contents serve no other purpose than confirming that you've recalled the definition you thought the symbol represented.

Symbol

The Stock Definition Dialog refers to a stock symbol and the Option Definition Dialog refers to an option symbol. The concepts are identical, but uniqueness is instrument dependent, meaning that you can define a stock and an option with the same exact symbol and they won't collide with one another in the database. You might confuse yourself by having an option and a stock named Ford, but the database will keep them straight. Any string of characters will suffice as the symbol - however, using the generally accepted exchange registered symbols have benefits discussed in the next section.

The database locates instrument (stock or option) definitions using the symbol you provide in the control located in the top left area of the dialog. This control is a combo-box, which means it has both edit and drop-down capabilities. You can recall instrument definitions by selecting a symbol from the drop-down box, or by a combination of 'typing' and scrolling. It supports auto-completion, so the typing required on recall is minimal. There's no sense going to extra effort

for first letter capitalization because all symbols are forced into upper case when the instrument definition is saved to the database.

Using an exchange registered symbol

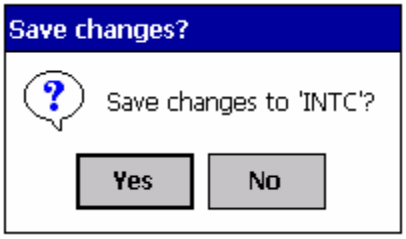
You can use any arbitrary symbol in an instrument definition, but there are advantages to using exchange registered symbols. For example, suppose you set up your database using 'AMAT' as the symbol for Applied Materials Inc. Later, you use the Option Chain Retriever (in the Tools menu) to download options derived from Applied Materials stock. In the process of fetching option pricing and volume information, the Option Chain Retriever will automatically update the price of Applied Materials stock. The benefit of using the exchange registered symbol is that you can run with the preference to confirm stock price updates disabled (in the Confirmation Options dialog), and let stock price updates sail through without intervention. The default is to let the stock price updates go through without confirmation.

Conversely, if you had used 'AMAT' to refer to Amalgamated Mining and Technologies in your database, and you subsequently desire to use the Option Chain Retriever to get the options for 'AMAT' (by which the rest of the world refers to Applied Materials Inc), you could potentially overwrite the price of your AMAT with the current market price of Applied Materials. 'Potentially' enters the game because you can require that NillaHedge confirm all stock price updates from the Option Chain Retriever by setting a preference in the Confirmation Options dialog, so you have the opportunity to cancel the update if you come to your senses just before the price would get committed to the database. Obviously, this is only a patch on a bad situation - you have forced yourself into manually updating prices for AMAT forever.

A similar situation exists for option symbols.

Saving an Instrument Definition

Suppose that you haven't modified the default values of the confirmation options and have just defined an instrument with the symbol 'INTC'. When you click the OK button in the upper right hand corner of the dialog, a confirmation dialog like the one at left will be displayed. Screen space on the PocketPC is precious and many of the dialogs are packed with controls, so instrument (stock and option) definition dialogs post a small confirmation dialog, asking you to confirm or cancel saving the changes you've made to the definition as a substitute for explicitly including a Cancel button. When you initially define an instrument, it may seem superfluous to ask if you really meant to save the definition, but later when you're editing a preexisting definition, the opportunity to cancel the save may prove more useful.

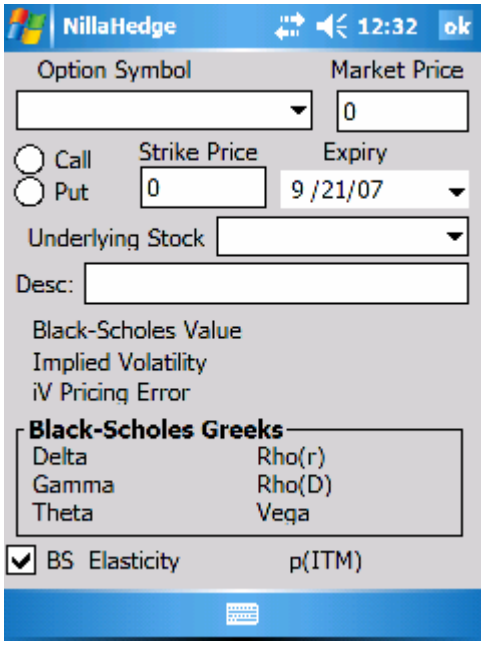


Confirmation Options

If you'd rather opt out of confirmations like these, you can use the Confirmation Options dialog to uncheck the preference labeled 'Definition dialogs – close'. When this preference is unchecked, subsequent close events in any of the three instrument definition dialogs will simply update the database without asking permission.

If you've already detoured through the Confirmation Options, you may have noticed a preference labeled 'Definition dialogs – change symbol'. This preference operates similar to 'Definition dialogs – close', but is triggered by changing the value of the stock symbol while one or more of the remaining dialog controls contains a value different from the associated value in the database. Naturally, if confirmation is enabled and you've never saved an instrument definition with that symbol before, then a confirmation dialog will post no matter what state the controls are in.

Option Definition Dialog



The Option Definition Dialog is one of two ways to create an option definition in NillaHedge. The other is to use the Option Chain Retriever to save one of the options displayed in its options list, but we'll get to that later. To define an option from scratch, you'll need the option's symbol, as well as its market price, strike price, expiration date, underlying stock symbol, and of course whether it's a put or a call.

Option Symbol

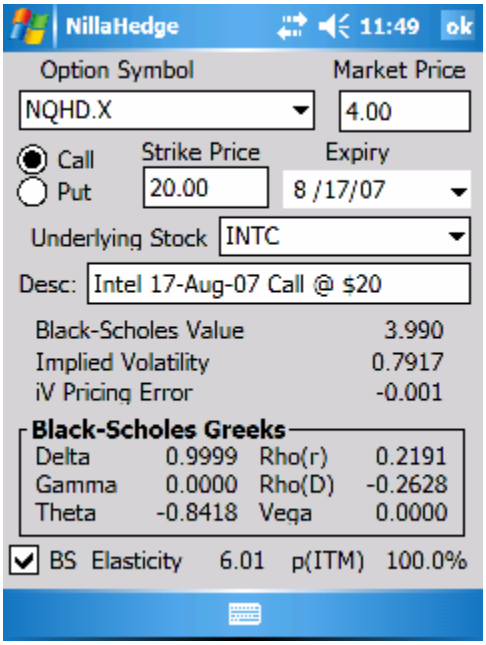
Refer to the Symbol / Identifier discussion in the Instrument Definitions section.

Automated price updates depend on internet sources which catalogue pricing information using exchange registered symbols. No confirmation option allows you to interfere with option price updates, so it's imperative that you stick with the exchange registered option symbols.

Market Price & Strike Price

Market price and strike price are currency denominated values.

Expiry



The Expiry date picker captures the option's expiration date. The vast majority of stock options expire on the third Friday of the month (technically the third Saturday, but the exchanges are closed on Saturdays), so the convention is to say they expire on the third Friday. Be careful to specify the correct date. One could argue that the day of the month in the expiry date is superfluous because options always (effectively) expire on the third Friday so you'd be right insofar as exchange registered issues go. However, since the Option Chain Retriever will automatically save exchange traded options directly into the database, including the exact expiration date, we decided to leave exact date flexibility in the Option Definition Dialog. Unfortunately, with that flexibility you also get the burden of accurately specifying the expiry date each time you define an option manually. Sorry about that.

Put / Call

The Put / Call radio button pair is technically a tri-state. It is initialized to an undefined state, which prevents analysis, forcing you to choose a valid value. You might ask, why not just pre-

select Call as the default value and save the user from a pen-click, half of the time? Well, it's because an invalid default value forces the user to proactively select a valid value, thus minimizing the potential of defining an option with an incorrect Put/Call value as an oversight.

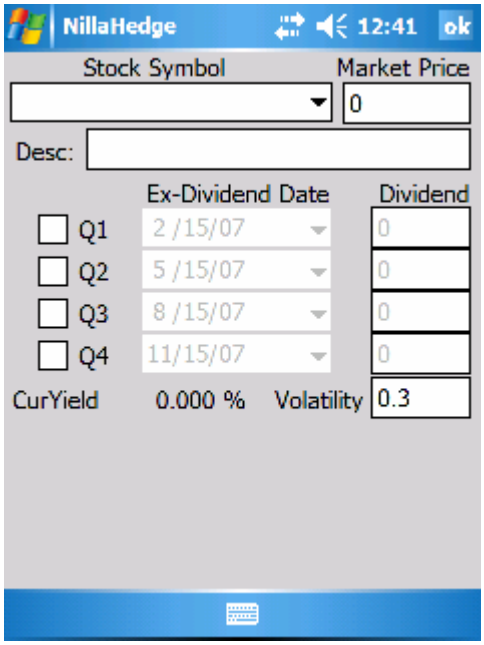
Underlying Stock

The Underlying Stock is a combo-box control, so you can either type the stock symbol or pick it from a list of stock symbols already defined in the database. If the specified stock doesn't already exist in the database or it has zero volatility or zero market value, analysis will be disabled, resulting in a display like the one on the previous page.

However, if there is an underlying stock defined in the database with positive market value and positive volatility, the option can be analyzed, producing analytical results like those at right.

All of the analytical information presented below the description field also appears in the Option Analyzer. Please refer to the Glossary and the section on the Option Analyzer to learn more about implied volatility, Black-Scholes value and greeks, elasticity, and the probability of being in the money, $p(ITM)$.

Stock Definition Dialog



The Stock Definition Dialog includes controls for entering a stock symbol, the stock's volatility, its current market price, a brief description, and a number of controls supporting quarterly dividends.

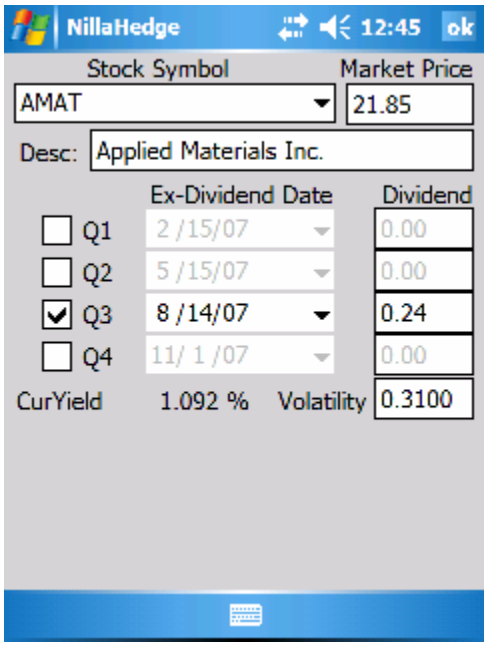
Stock Symbol

Refer to the Symbol / Identifier discussion in the Instrument Definitions section above.

Volatility

If you never intend to analyze options on a particular stock, then volatility can be ignored because it's only used to price and analyze options derived from the stock. However, if you are interested in analyzing options on a stock, you should know a couple of things. First, many sources of volatility report the volatility as a percentage, e.g. if the volatility is 0.391, they may report 39.1%. NillaHedge expects volatility to be the un-scaled floating point value, not the percentage. An excellent source for volatility values (reported as percentages) is Robert's Historical Stock Volatilities.[3]

Dividends



The stock price obviously affects the capital value of your portfolio, and dividends are a motive force behind income reporting (elsewhere in NillaHedge). If you've done any amount of income investing, you will have discovered that there can be several weeks between the ex-dividend date and the issue date for the dividend check, but NillaHedge only has only one set of dates and uses the ex-dividend date for both purposes.

There are several justifications for this simplification. First, option valuation is driven by the ex-dividend date not the payment date. Second, capturing eight dates associated with dividends would substantially complicate the Stock Definition Dialog and pose a greater data entry burden on the user. Finally, given the limited storage capabilities of the typical PocketPC, storing just four dates instead of eight, saves storage space. The side effect is that the current yield may be affected. It will usually be inconsequential.

[3] http://www.intrepid.com/~robertl/stock-vols1.html. Volatility is also defined in the glossary.

You'll note that the date picker controls in the Stock Definition Dialog can specify years as well as months and the day of the month. NillaHedge assumes that dividends recur annually on the given calendar date, ignoring the year specified. Each of the four dividend date pickers is restricted to the months in the associated calendar quarter. If a stock pays dividends just once per year, in May, the only place you can successfully specify the date is in the date picker immediately to the right of the Q2 checkbox. You'll also find that the dividend date picker and dividend amount for the Q2 dividend are disabled while the associated quarterly checkbox is not checked. Once you check the checkbox, the date picker and dividend amount controls are enabled. If you later desire to experiment with the effects of discontinuing the dividend, you need only disable the checkbox for the associated dividend and save the modified stock definition back to the database. The ex-dividend date and the dividend amount are retained in the database, but that dividend is excluded from all subsequent income calculations. At the end of the experiment, you can simply re-check the Q2 checkbox and re-save the stock definition.

Current Yield

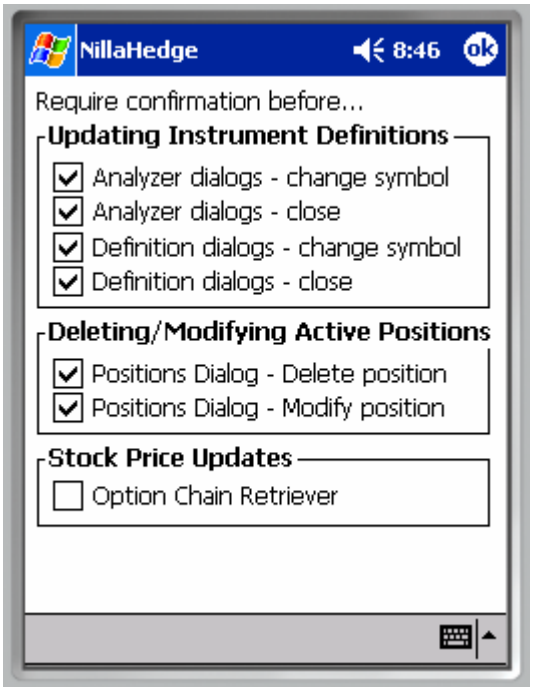
When a stock price and one or more quarterly dividends are defined, the dialog will report the current yield of the dividends as a percentage of the stock price.

Definition dependencies

Since vanilla put and call options refer to an underlying stock, you may wonder if you must create a stock definition before creating an option definition which refers to it. The answer is no. If a stock definition does not exist at the time that an option definition referring to it is saved, a placeholder stock definition will be created for you. It will be up to you to enter appropriate values for the market price, volatility, dividends, and description, if any. The Stock Definition Dialog is the only place where you can enter a description, dividend dates and amounts for a stock, but the Option Analyzer also allows you to modify the stock price and volatility for an option's underlying stock. Additionally, the Option Chain Retriever will automatically update the stock price whenever it successfully retrieves an option chain for a particular stock.

Preferences Dialogs

There are two preferences dialogs in NillaHedge, both launched from the Edit menu.



The Confirmation Options dialog allows you to view and modify the current value of seven confirmation options which affect behaviors in the analyzer dialogs, instrument definition dialogs, the Positions Dialog, the Portfolio Navigator, and the Option Chain Retriever.

The Positions List Options dialog allows you to view and modify the visibility of columns in positions lists that appear in the Positions Dialog and the Portfolio Navigator.

Confirmation Options

There are three groups of preferences in the Confirmation Options dialog. Each preference controls whether to require user confirmation before doing something irreversible to the database. The first group controls whether to confirm instrument (option or stock) definition updates. The second group controls whether to confirm portfolio position modifications and deletions. The third group just controls whether to confirm stock price updates in the Option Chain Retriever.

Dialog Close Events

The second and fourth check boxes indicate your desire to have NillaHedge post a confirmation dialog before updating an instrument definition when you close the dialog. The second check box affects close events in the Option Analyzer and the fourth check box affects close events in the instrument definition dialogs. The default value for both preferences is to require confirmation.

Change Symbol Events

The first and third check boxes indicate your desire to have NillaHedge post a confirmation dialog before updating an instrument definition when you change the symbol (identifier) in one of the instrument definition or analyzer dialogs. The first check box regulates change symbol behavior in the Option Analyzer dialog. The third check box dictates change symbol behavior in the instrument definition dialogs. The default value for both preferences is to require confirmation.

Delete and Modify Events

The preferences in the second group affect whether you're queried for confirmation after pressing the Delete or Modify buttons in the Positions dialog. Confirming position deletes is

probably a good idea, but it's not a huge tragedy if you don't confirm modify operations, because you'll have the opportunity to re-Enter the position before quitting the Positions Dialog, but no warning will post when you close the dialog with values present in the controls above the Enter button. The default value for both preferences is to require confirmation.

Stock Price Updates

The preference in the third group merely puts you in the loop before the stock price can be updated by the Option Chain Retriever. Its default value is false, in the hope that you will wisely use exchange registered stock symbols, making such confirmations superfluous.

Option Price Updates

You might wonder, if there's a preference for confirming stock price updates in the Option Chain Retriever, why not do the same for option price updates? First, the two types of price update don't generate the same amount of user interaction. There is only one stock price per 'Fetch', so there would never be more than one confirmation posted on its account. In contrast, there might be a half-dozen or more options defined in your database that might need to have their prices updated as a result of a single 'Fetch'. The criteria used to decide whether to update the option price is that an option definition exists, not whether it would affect your portfolio value (i.e. all definitions will attempt an update, not just those with associated positions).

As a result, it could get really irritating working through all of those confirmation dialogs, so additional logic would be required to manage possibilities like, 'No, to all', 'Yes, to all', 'Abort', etc. All of that complexity to prevent updates to option definitions that might have been defined with an exchange registered symbol, but didn't represent the issue referred to by the registered symbol. It further requires that you'd recognize that the symbol you used for your special option now collides with an exchange registered option. Ultimately, it seemed unlikely that the same user that would unwisely pick an exchange standard symbol to represent something other than the normally associated option would subsequently recognize that it was being inappropriately updated. In short, we believe that option price update confirmations would probably never get used, so the opportunity to prevent automatic updates is not offered.

We therefore strongly recommended that you stick with exchange registered option symbols to define options that the rest of the world associates with those symbols.

Positions List Options

Positions List Options are virtually self-explanatory. The preference names correspond with columns in the Positions dialog and the Portfolio Navigator. The preferences in the left column affect the visibility of columns in the Positions dialog and the preferences in the right column affect the visibility of columns in the Portfolio Navigator.

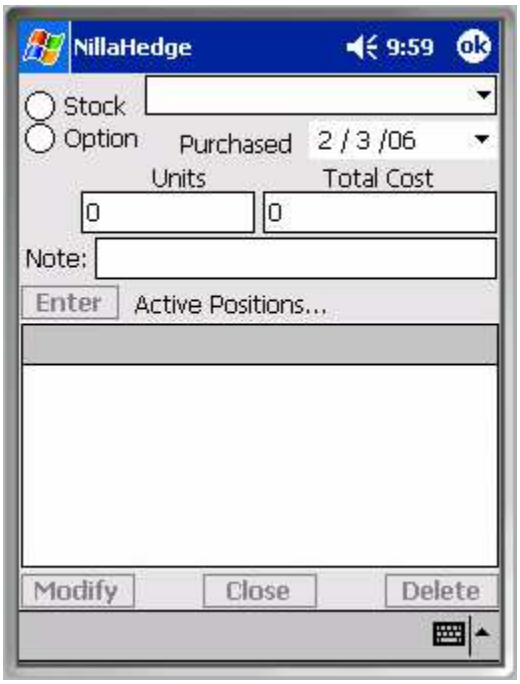
All of the preferences have the default value of enabled (checked), so all columns will be visible in each of the affected dialogs. The columns appear in the same order that they occur in the preferences list at right.

The only preference that doesn't coincide with a column heading is the very last one on the right – 'Initially Hide Positions'. The Portfolio Navigator has many row types; the row type at the leaf level in the hierarchy displays a position in a format almost identical to the display used in the Positions dialog.

The justifications for a default of initially suppressing the display of positions went something like this. 1) Positions are always displayed in the Positions dialog. 2) You have the option of expanding an issue's summary node to see the positions that contribute to that subtotal row. 3) Portfolios would require more scrolling if the positions were visible. 4) It would be quite a bit of work to toggle all of the issue expansion nodes off, to facilitate fitting more summary information onto the small screen.

Position Dialogs

There are three dialogs in NillaHedge that deal with positions, the Positions Dialog, the Portfolio Navigator, and the Positions Transcripts dialog. The Positions Dialog offers the opportunity to view or create the positions linked to a specific stock or option issue.



The Portfolio Navigator provides a top-down view of the entire portfolio, optionally expanding or collapsing branches in the hierarchy down to individual positions at the leaf level.

The Positions Transcripts dialog provides a text transcript equivalent to the leaf level in the Portfolio Navigator. The intent is to export these journal entries for review, tax records, and other documentary purposes.

The Positions Dialog

The Positions Dialog is where all positions in your portfolio are created. NillaHedge tries to anticipate which instrument type you'll want to create positions for. If you haven't defined any options or stocks, NillaHedge won't be able to guess an instrument type, so it will initialize the Positions Dialog with the Symbol combo-box disabled and no selected value in the radio button group as shown above.

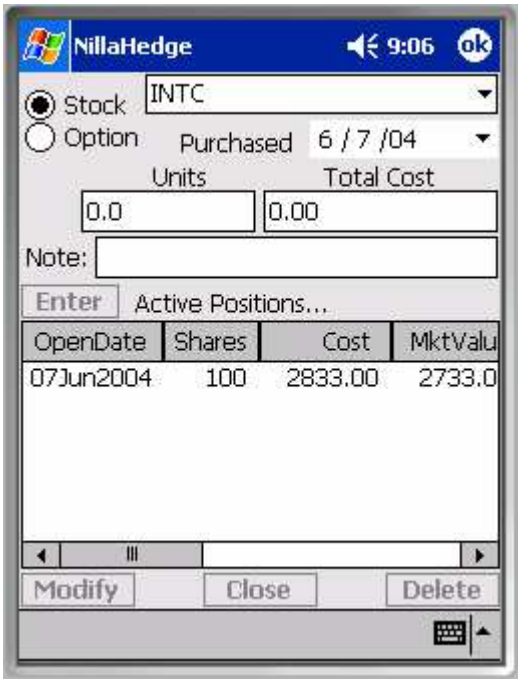
However, if you have defined some instruments, NillaHedge will select an instrument type based on the type you last defined, created a position for, or analyzed. For example, if you just defined a stock, the Positions Dialog will choose Stock in the radio button group and load the known stock symbols into the combo-box. In the next screen shot, we've selected Intel Corp (INTC) from that list and filled in values for Units

Note that all of the buttons that operate on the positions list (Enter, Modify, Close, and Delete) are disabled for an issue with no positions.

Symbol (Identifier)

When the instrument type radio button group is set to Option, the symbol combo-box selects option symbols. When the group is set to Stock, the symbol combo-box selects stock symbols.

Note that it's not necessary to select a symbol from those already defined in the database. If you enter a new symbol, a placeholder instrument definition will be created for you, though NillaHedge will not make any assumptions about the issue's current market price (e.g. based on the number of units purchased and their total cost). Using zero as the market price in the placeholder definition serves as a reminder that its value has never been set.



Purchase Date

The current date is used as the default value for the Purchase date, but future dates are disabled, so it's not possible to enter pro forma positions.

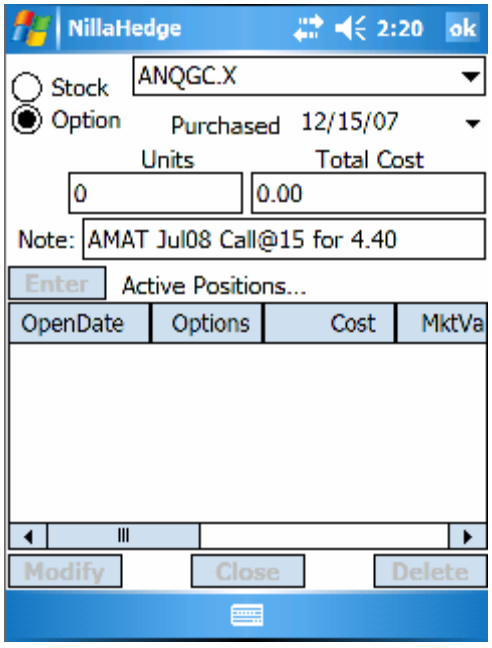
Number of Units (Options or Shares)

The number of units (options or shares) in a position is stored as a double precision floating point number. While fractions of an option don't find much practical application, stock reinvestment plans often produce fractional shares of stock, hence the floating point representation. For short sales, specify the number of units as a negative number. Please note that the unit of measure for an options position is one option, not a contract consisting of 100 options. For example, if you buy 3 option contracts, you would enter 300 in the Units edit-box.

Total Cost

Total Cost is also stored as a double precision floating point value. The presumption is that it represents the cost of the position including any transaction fees. Note that the cost associated with a short sale should be negative, thus representing an inflow of capital after expenses.

As an example, if you chose INTC as the stock symbol and enter 100 as the number of shares, the dialog calculates and enters the cost of the position based on the market price of INTC, as currently defined in the database. No fees are added at this point (that's left for you to do manually). We'll set the date back a year and add $100 to the total cost.



Option/Stock Radio Button Group

The Stock/Option radio button group controls which symbol table is loaded into the Symbol combo-box.

Note

The Note field is provided to document almost anything you'd like to associate with a position.

When the Option/Stock Radio Button Group is set to Option, a string is pre-loaded into the Note box describing the current option in the symbol selector. The string includes exchange symbol for the option's underlying stock, the option's expiration date, whether it is a Put or Call option, the option's strike price, and the option's current market price. An example for the ANQGC.X is shown above right. Its underlying stock is Applied Materials (exchange symbol AMAT); it is a July 2008 Call option struck at $15; and its current market price is $4.40.

Enter Button

Once a symbol has been entered and there are values for the number of shares and the total cost, the Enter button will be enabled.[4] As soon as an entry appears in the position list control (below the Enter button), the position has been saved in the database. Closing the dialog only discards the contents of the fields (above the Enter button) used to create a position.

Positions List

The position has been committed to the database and a row is added to the positions list for INTC to depict the current state of the database.

OpenDate	Shares	Cost	MktValu
17Jan2004	200	5366.00	5466.0
07Jun2004	100	2833.00	2733.0
Total	300	8199.00	8199.0

Note that the number of shares and the total cost fields now contain zeroes, the Note field has been cleared and the Enter button has been disabled.

MktValue	CapGain	Income	NetGain
5466.00	100.00	96.00	196.00
2733.00	-100.00	24.00	-76.00
8199.00	0.00	120.00	120.00

Since INTC was defined previously with a market price of 27.33, the market value of the position reflects the number of shares times the market price of the stock. If we scroll to the right in the positions list, we can see some of the remaining columns in the list control. Since we added $100 to the cost of the position, the Capital Gain shows a loss of $100. INTC pays a $0.24 dividend once annually, so 100 shares of dividend income is displayed in the Income column. The Net Gain column merely sums the Capital Gain and

NetGain	% Yield	Note
196.00	2.548	Bingo haul
-76.00	-2.668	OTB winnings
120.00	0.745	Total

[4] The initial results of clicking the Enter button are shown above right, with scroll-right addenda below it.

Income column entries and the '% Yield' column annualizes the Net Gain over the holding period.

If we scroll to the right, we can see the Note we entered above as our source of funds.

Let's see what happens when we add another INTC position. We'll change the date and buy 200 shares for $5366, including transaction fees, and note the purchase as being financed by a haul in a Bingo game.

As before, the Enter button becomes disabled, the Note is cleared, and the Units and Total Cost fields are zeroed out. The Positions List now shows the following contents:

The 'Bingo haul' position has become the topmost position, showing a positive Net Gain and annualized yield. Obviously, positions need not be limited to outright purchases, they can just as easily be the result of dividend reinvestment.

A Total row, highlighted in cyan, has been added to depict the sums for each of the columns - the exception being the '% Yield' column – this Total row entry is the cost weighted average annualized yield of the contributing positions, so you can get immediate feedback on how well cost averaging is working for you. The total row is only visible when more than one position exists for the issue you've selected.

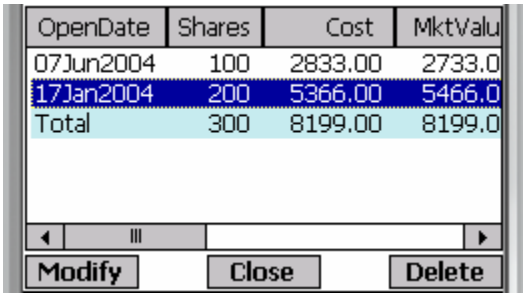
Positions List Columns

Column headings are generally self explanatory, so we'll focus on a few things that may not be as readily apparent. First, the list control supports column resizing, reordering, and sorting (toggles between ascending and descending). If a total row is present, it is not included in the sort. Stocks with dividends generate income, so there's a column displaying income when the radio button group selects Stock. The Net Gain column displays the sum of the Capital Gain and Income columns and is also only displayed for stocks. When the radio button group selects Option, you'll find another column (assuming its enabled) just to the left of the Note column displaying the exercise value of the position.

You'll note that the second column (when the Purchase Date and Options/Shares preferences are both enabled) changes its name to reflect what sort of units the position represents.

Managing Display of the Positions List

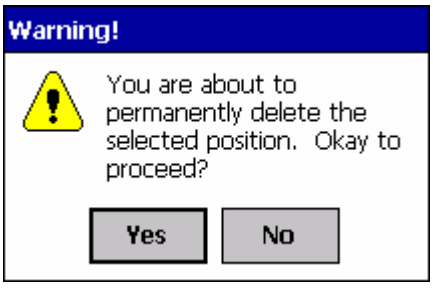
Clearly, you can't see the contents of all columns without scrolling the Positions List horizontally, but you can disable the display of any of the columns in the Positions List Options dialog, thus reducing the need to scroll horizontally.



Managing the Contents of the Positions List

The three buttons below the Positions List allow you to manage the list of positions displayed above. If you select one of the positions in the list, you'll see the row highlight and the three buttons at the bottom of the screen become enabled. You may notice that you can't select the total row – it's not a real position, just a summary entry in the list control.

Here's what happens when you select one of the three buttons at the bottom of the dialog.

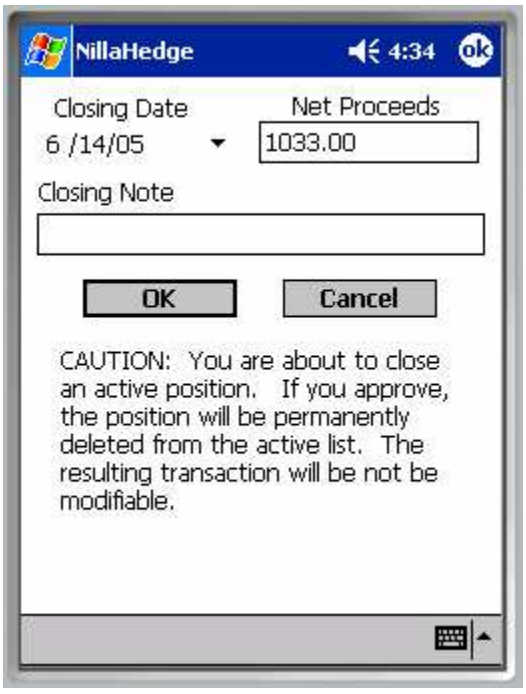


Delete

The Delete button is the simplest of the three. Selecting it causes the message box at right to post over the dialog.[5] If you click 'Yes', it will disappear from the database forever. The Delete button is the only one of the three bottom buttons that supports multiple selections.

Modify

The Modify button is very much like the Delete button, in that it warns you that you are about to delete the selected position, and once you select 'Yes', the position will be permanently deleted from the database, just as it promised.[6] The difference is that Modify overwrites, without asking permission, all of the fields in the dialog with values taken from the position you are 'modifying'. Clearly, you shouldn't use the Modify button if you have typed information into the fields above the Enter button that you care about.



After you complete your modifications, you must re-Enter the position in the database. Until it appears in the Positions List below the Enter button, it's not saved in the database – that's why the warning message says "you are about to permanently delete the selected position" when you just selected Modify.

Close

The Close button also has irreversible consequences, but it does not have an associated preference in the Confirmation Options Dialog because it needs to capture additional information along with your approval to proceed. The Close Position Dialog completely overlays the Positions Dialog and collects three things from you which enable converting it into a closed position. The date the position was closed, the net proceeds from the sale, and a closing note. The closing

[5] You can bypass warning messages posted by the Delete button by disabling the preference 'Positions Dialog – Delete position' in the Confirmation Options Dialog.

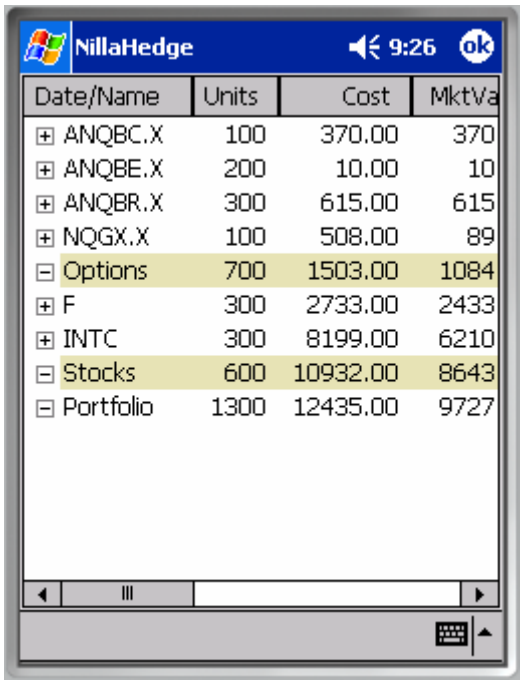
[6] You can bypass warning messages posted by the Modify button by disabling the preference 'Positions Dialog – Modify position' in the Confirmation Options Dialog. .

date can be no later than the current date. Upon selecting the 'OK' button, a 'closed position' is created in the database with all of the information previously associated with the active (open) position; the active (open) position is then deleted.

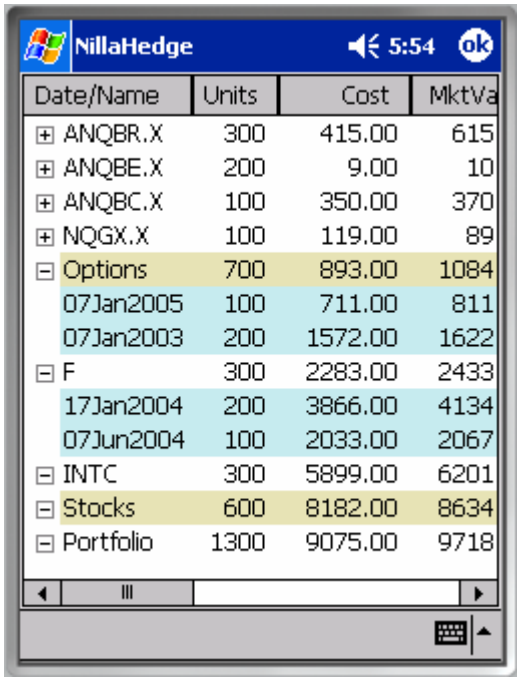
By design, there is no mechanism for modifying a closed position – it can't be deleted, modified, or converted back into an active (open) position, but you can get transcripts of all closed positions according to the year in which they were closed (see the Positions Transcripts Dialog on the Tools menu).

Portfolio Navigator

The Portfolio Navigator is the second positions dialog in NillaHedge. It differs from the Positions Dialog in that it doesn't allow you to close, delete, enter, or modify positions in your portfolio. Its purpose is to display positions and summarize your portfolio at various levels. The hierarchical display implements a folding spreadsheet whose branches can be expanded to obtain more detail or collapsed to a summary. The example at right depicts a portfolio containing positions in three Applied Materials options (ANQBC.X, ANQBE.X, ANQBR.X), one Intel option (NQGX.X), and two stocks (Ford and Intel). The position rows are initially invisible, so all you see at right are the issue summary rows and the total row for all bonds in the portfolio.



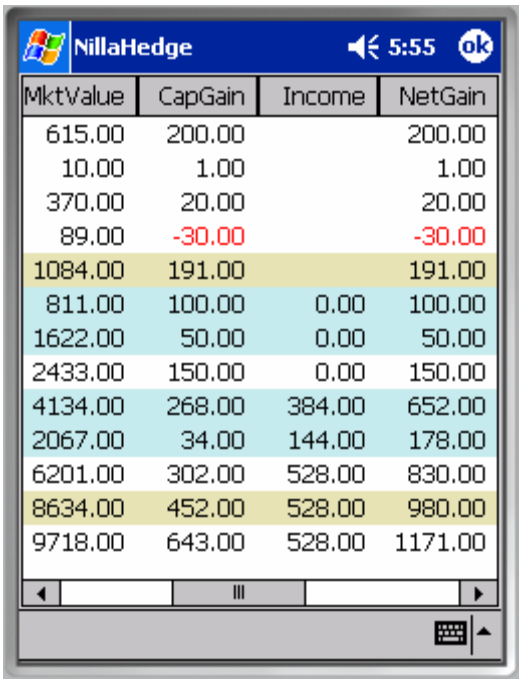
Date/Name	Units	Cost	MktVa
⊞ ANQBC.X	100	370.00	370
⊞ ANQBE.X	200	10.00	10
⊞ ANQBR.X	300	615.00	615
⊞ NQGX.X	100	508.00	89
⊟ Options	700	1503.00	1084
⊞ F	300	2733.00	2433
⊞ INTC	300	8199.00	6210
⊟ Stocks	600	10932.00	8643
⊟ Portfolio	1300	12435.00	9727



Date/Name	Units	Cost	MktVa
⊞ ANQBR.X	300	415.00	615
⊞ ANQBE.X	200	9.00	10
⊞ ANQBC.X	100	350.00	370
⊞ NQGX.X	100	119.00	89
⊟ Options	700	893.00	1084
07Jan2005	100	711.00	811
07Jan2003	200	1572.00	1622
⊟ F	300	2283.00	2433
17Jan2004	200	3866.00	4134
07Jun2004	100	2033.00	2067
⊟ INTC	300	5899.00	6201
⊟ Stocks	600	8182.00	8634
⊟ Portfolio	1300	9075.00	9718

Expanding/Collapsing Branches

If you click on the ⊞ icon next to the symbol (identifier), individual positions will be displayed above the issue's summary row. For example, if you expand the 'F' and 'INTC' branches in the example above, you'll get the display at left. Note that position rows always appear *above* the issue's summary row, as you might do if you were tallying the positions for each issue. To collapse a branch, just click on the issue's summary row ⊟ icon.



MktValue	CapGain	Income	NetGain
615.00	200.00		200.00
10.00	1.00		1.00
370.00	20.00		20.00
89.00	-30.00		-30.00
1084.00	191.00		191.00
811.00	100.00	0.00	100.00
1622.00	50.00	0.00	50.00
2433.00	150.00	0.00	150.00
4134.00	268.00	384.00	652.00
2067.00	34.00	144.00	178.00
6201.00	302.00	528.00	830.00
8634.00	452.00	528.00	980.00
9718.00	643.00	528.00	1171.00

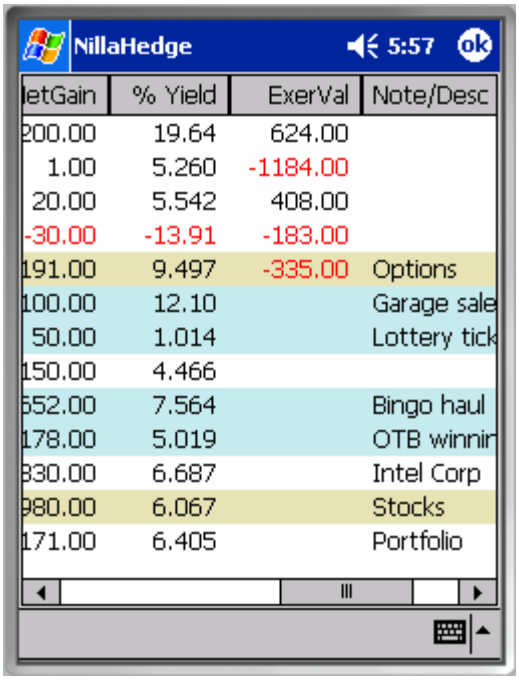
Row Background Colors

The summary rows for the Options folder and the Stocks folder have manila backgrounds, symbolizing manila folders. Position rows have a powder blue background - hopefully alliteration will serve as the mnemonic there. The portfolio summary row and issue summary rows and use a plain white background.

Columns

The Portfolio Navigator treats columns slightly differently than the Positions Dialog. The columns available are Date/Name, Units, Cost, MktValue, CapGain, Income, NetGain, % Yield, ExerVal, and Note/Desc. Dividend income contributes to the net gain. Net gain is the basis of the annualized yield calculation.

NetDate/Name and Note/Desc columns present information which depend on the row type. Position rows, display the purchase date in the Date/Name column and the Note you entered when you created the position in the Positions Dialog in the Navigator's Note/Desc column.

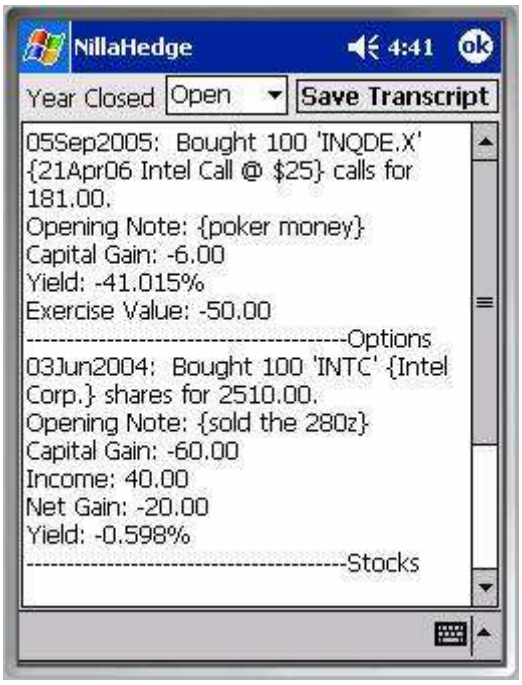


Issue summary rows display the issue's symbol in the Date/Name column and the description you created in the instrument definition dialog in Navigator's Note/Desc column. Columns can be reordered using tap and drag, but sorting is not currently available. You can use Positions List Options to prevent some columns from being displayed. The default is for all columns to be visible.

In this example, the annualized yield for the portfolio as a whole is 6.405%.

Note: Purchase prices and dividend rates in this example are entirely fictional.

Positions Transcripts



The Positions Transcripts dialog collects information for all open positions or for all positions closed within a given calendar year and presents a textual report summarizing the activity. Of course, they are useful as journals at tax time, but transcripts also serve as a faster means of reviewing the current state of capital gains, coupon income, annualized yields, etc. because scrolling a plain text window is faster than scrolling a list control and you can see the derivative data all at once so you don't have to scroll right and left to get a picture of what's going on.

Year Closed

The 'Year Closed' combo-box allows you to choose between 'Open' and any years for which closed positions exist. If there is only one year, e.g. all positions are active (open) or all closed positions were closed in the same year, then that year's positions will be loaded by default. If there are open and closed positions, Open positions will be loaded by default. Otherwise the most recent year's transcript will be loaded by default.

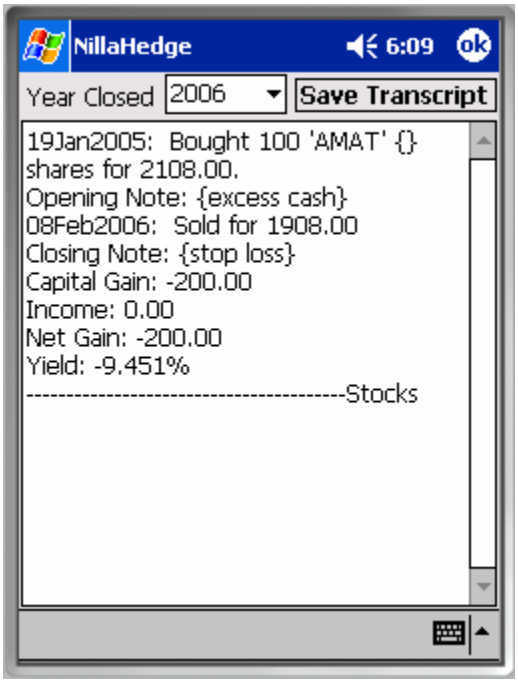
The Transcript

In the example above right, you can see the first two journal entries from the list of open positions. Each entry includes: an opening date, the number of shares or options purchased, the stock or option symbol, the description associated with the issue, the total cost of the position, any note you may have created with the position, and derivative information including capital gain, income, net gain, and the annualized yield represented by the net gain. Dividends from the purchase date to the present date contribute to income figures. Portfolio totals for cost, capital gain, income, and net gain are posted below the positions listed in the transcript. The cost weighted annualized yield of all positions in the transcript completes the picture.

A transcript containing one closed positions is shown at right. It adds the closing date and closing note entered at the time the position was closed to the information associated with an open position.

The transcript displayed is not saved to a file until you choose to do so manually.

Save Transcript



The 'Save Transcript' button allows you to save the transcript to a file, for review and editing outside NillaHedge and subsequent upload to a desktop computer. The file dialog shown below is posted after clicking the Save Transcript button. It allows you to save the transcript to the file name of your choosing.

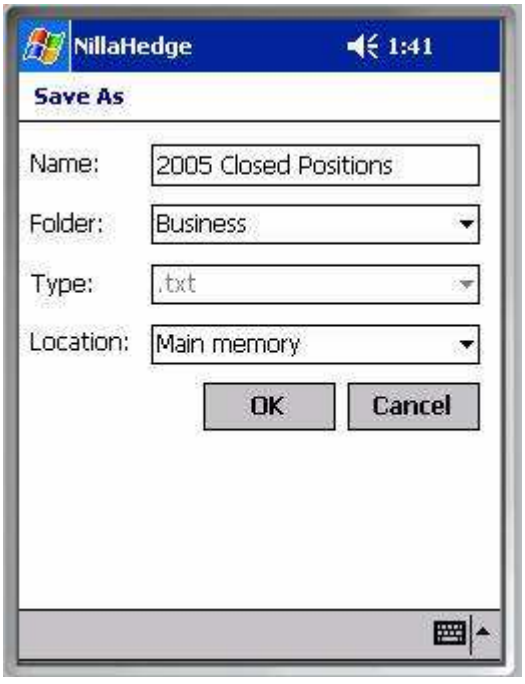
Database Traversal

The Positions Transcripts dialog traverses the database differently than other tools in NillaHedge. Other NillaHedge tools access positions through the instrument (stock and option) definitions, since each tracks its own list of positions.

Positions transcripts are generated by bypassing all of the instrument definitions and directly accessing the portfolio positions. This approach has both tactical and strategic advantages. From a tactical perspective, it saves CPU time (something that should always be conserved on a Pocket-PC platform) which might otherwise be wasted inspecting instrument definitions that don't have associated positions.

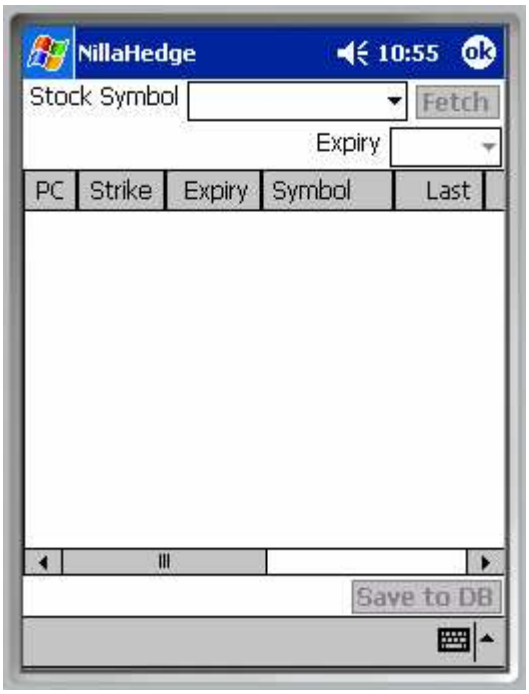
From a strategic perspective, directly accessing the portfolio positions enhances robustness by potentially salvaging position information from a partially corrupted database. Hopefully, you'll never have to find out whether this capability actually saves your bacon or not.

The downside of initially bypassing the instrument definitions is that positions associated with a particular issue won't necessarily be contiguous in the transcript. The order in which the journal entries appear is generally the order in which you created the positions, except that space occupied by closed and deleted positions is recycled by subsequently created positions. For example, if you create twenty positions in your portfolio before deleting the second one ever created and then create a new position, the new one will appear second when you generate an open positions transcript. Given the benefits of efficient CPU utilization and the potential to salvage a corrupt database, journal entry disorder was viewed as a reasonable inconvenience. Tax agencies care more about completeness than order, and that's what the transcript is intended to address.



Option Retrieval, Price Updates

Option Chain Retriever



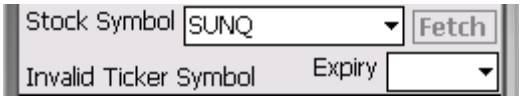
The Option Chain Retriever downloads option pricing and related information via the internet. It captures a chain of options expiring on a given date and loads up the Option Chain list control, one row for each option.

It automatically updates the price of any option in your database found in a downloaded chain, but won't create any new option definitions automatically. It's very important to stick with exchange registered option symbols because the price update process doesn't allow the user disapprove or otherwise bypass price updates.

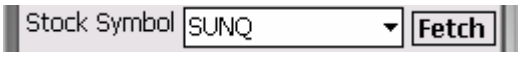
The Option Chain Retriever will also silently update the price of the underlying stock, unless you set the Confirm Save Preferences to require user confirmation. If confirmation is required, the Option Chain Retriever will post a confirmation dialog before modifying the stock price.

The Option Chain Retriever is initialized with no stock symbol and both buttons disabled.

Stock Symbol



The Stock Symbol is a combo-box, supporting drop-down and edit modes of input. You can either select the symbol for a stock you already have defined in the database via the drop-down box, or use the Input Panel to type a stock symbol not yet in your database. We entered 'AMAT' in the example at right. Once a symbol is available, the 'Fetch' button becomes enabled.

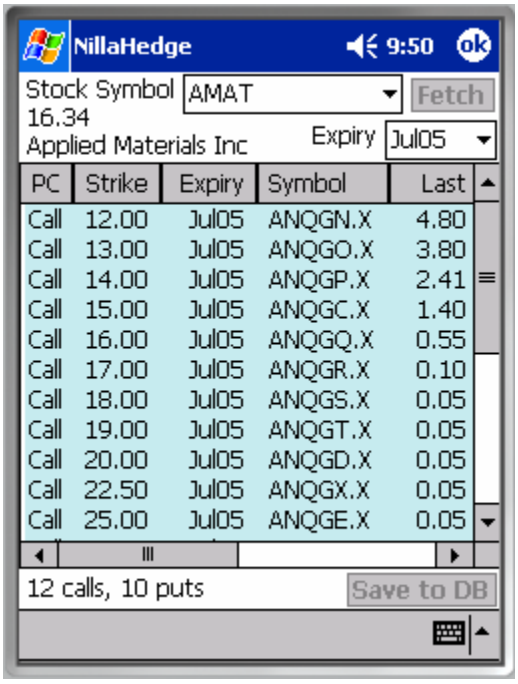


Note: There is no local cache of valid stock exchange symbols in NillaHedge - the server is the arbiter of validity for stock symbols. Since it takes a few seconds to hear back from the server, you'll be more productive if you avoid fetching invalid symbols.

Fetch Button

Once enabled, clicking the Fetch button will initiate a connection with the server to retrieve an option chain with the earliest possible expiration date for the company represented by the Stock Symbol. In the example above, we entered 'AMAT' to retrieve the options for Applied Materials Inc (whose Nasdaq symbol is 'AMAT'). The Fetch button is disabled as soon as the download is launched.

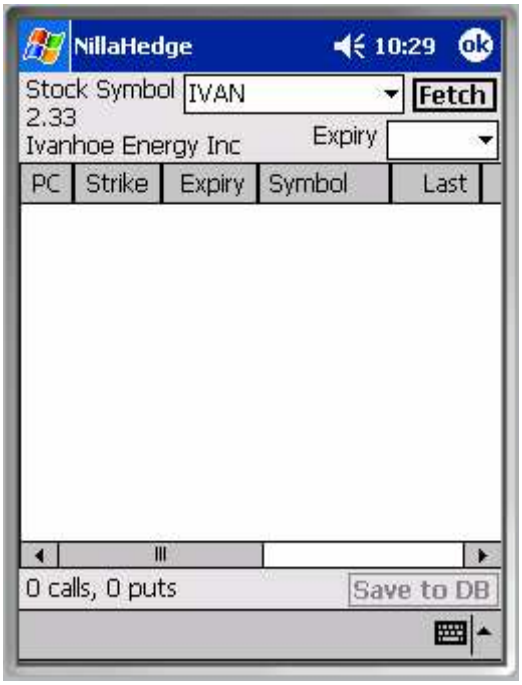
Status Messages



After clicking the Fetch button, a series of messages will appear in the status line at the bottom of the dialog (to the left of the 'Save to DB' button). The first status message is 'Opening Request…' letting you know that progress is underway. Opening a request is a local operation and should complete very quickly. If this message is still around after more than a second, it's likely that your internet connection is down.

The second status message, 'Sending Request…' indicates that NillaHedge is attempting to negotiate a connection with the server. Obtaining an initial connection can sometimes take three to five seconds, depending on the quality of your internet connection and the demand on the server, but once a connection has been established, subsequent requests generally proceed with sub-second elapsed times.

The third status message, 'Downloading…' indicates that a connection has been successfully established and the data is currently being copied from the server onto the PocketPC. Downloading can also experience variations in completion times, from less than a second to a couple of seconds, depending on the speed and quality of your connection.



The fourth status message, 'Extracting…' occurs during the phase where the list control is being populated with the information just retrieved. Here, the total elapsed time is entirely dependent on how fast your processor is and how many options are contained in a single options chain. For a stock with a dozen options, the extracting phase completes almost instantaneously, but it may take a couple of seconds to populate the list control if there are hundreds of options in a single download.

When the extraction phase completes, the status line indicates the number of puts and calls currently contained in the options list; the options list contains a row for each of the options found, the stock price and company name are displayed below 'Stock Symbol'; and the Expiry combo-box has been loaded with all known expiration dates for options on the specified stock symbol.

Stock Price and Company Name

The first result of extraction is the display of the company name and the current stock price associated with the symbol you requested options for. There's nothing magical here. The stock price is delayed by about fifteen minutes from the current market. The company name is provided so you can verify that you received what you intended to retrieve.

Expiry Dates

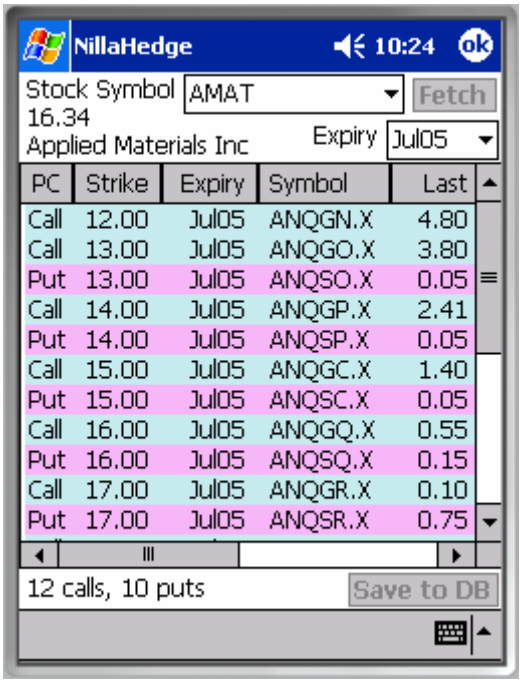
The next result of a successful download is that the Expiry combo-box is loaded with the known expiration months for options on the specified stock. Immediately after download, the Expiry combo-box displays the nearest term expiration date available. Subsequent expiration dates can be found in its drop-down box.

The Expiry combo-box serves two purposes. If you select a date for which you have previously downloaded options, the Expiry combo-box will restore the original sort order (if it has been modified) and scroll the options list so the first option matching the selected expiration date occupies the first row of the options list.

If you select a date for which you have not previously downloaded options, the Expiry combo-box will just enable the Fetch button, enabling you to retrieve options with that expiration date into the options list.

Option Chain List Control

The primary result of extraction is an option chain populating the central list control with columns indicating whether the option is a put or a call; its strike price; expiration month; option symbol; a set of prices (or derivative numbers): Last, Change, Bid, Ask; Volume, and the Opening Interest in the issue.



Highlight Color

Rows in the options list are color coded to indicate whether the option is a put or a call (making the first column redundant). Puts are highlighted in plum, while Calls are highlighted in cyan.

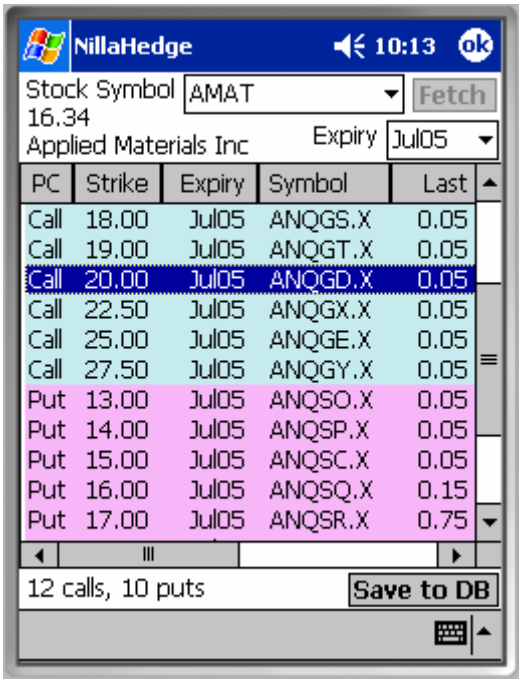
Column Sorting

All of the column headers act as sort buttons on the column. The first click is an ascending sort, the second produces a descending sort. The result of an ascending sort on Strike price is shown at right.

After sorting, it may be desirable to return to the original sort order. Since there's nothing intrinsic about the option pricing data that would allow a sort on the data that would restore the original order, the original sort order is hidden in the empty column after the Opening Interest

column. Its column header button (only about two characters wide) is blank, but it sorts using the list control's original sort order.

Save to Database



The 'Save to DB' Button is enabled whenever one or more rows are selected, even if the selected row doesn't currently appear within the viewable area, i.e. when you select a row and subsequently scroll the window. You can click, drag, and release to select a screen full at a time, or if you use a real or the builtin soft keyboard, you can use shift-click and control-click to add or subtract rows from the selected list.

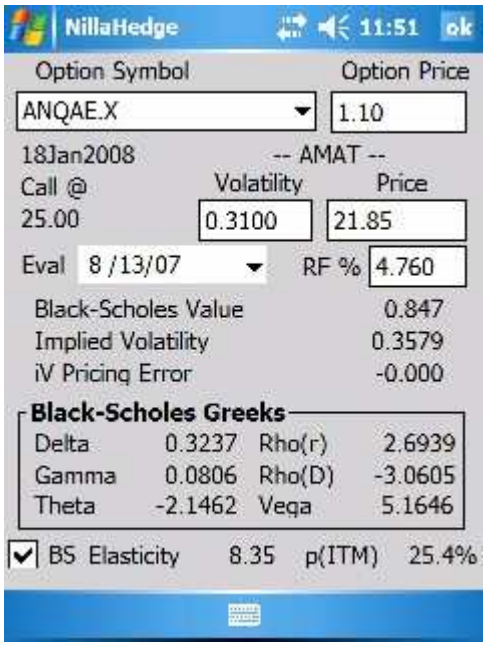
When you click 'Save to DB', the selected options are immediately saved to the database. Shortly thereafter, the rows will automatically be deselected, indicating completion of the operation. When the rows are deselected, the 'Save to DB' button will be disabled too.

The option definitions saved will be complete, even if you haven't previously defined the underlying stock in your database. But if that is the case, the stock will not have dividends defined and it will have a default value for the stock's volatility. It's wise to set dividends to accurate values because they affect the value of options drawn on that underlying, as well as all of the income calculations in the positions dialogs and the positions transcript.

Analytical Tools

Option Analyzer

The Option Analyzer dialog enables you to experiment with values for the risk free rate, option price, stock price, and stock volatility to better understand an option's sensitivity to changing market conditions. There is a subtle difference in the way that the Option Symbol combo-box works vs. how that control works in the Option Definition Dialog, so we'll address that immediately.



Option Symbol

The Option Symbol combo-box in an analyzer dialog doesn't allow you to create a new symbol as you can do in the Option Definition Dialog. All you can do is select one of the preexisting option symbols. Given that, we decided to always load the first option symbol found, so you instantly have meaningful output to review when you open the Option Analyzer.

Option Price

The Option Price edit box is a window on the database's stored value for the option price. If you change the option price here, the new value will be saved in the option definition when you change option symbols or quit the dialog. If you have the appropriate save confirmation preferences enabled, either of those actions will cause a confirmation dialog to post asking permission to update the database.

Expiry Date, Strike, Stock Symbol

Immediately below the Option Symbol combo-box, you can see several items that summarize the option definition. The expiration date, whether it's a put or a call, the strike price, and the symbol of the underlying stock (surrounded by dashes). In the example above, we can see that ANQAE.X is a call option on Applied Materials Inc. (NYSE symbol = 'AMAT'), struck at 25.0, expiring on 18-Jan-2008.

Volatility

The Stock Volatility edit box is a window on the database's stored value for the underlying stock's volatility. If you change the volatility here, the new value will be saved in the stock definition when you change option symbols or quit the dialog. If you have the appropriate save confirmation preferences enabled, either of those actions will cause a confirmation dialog to post asking permission to update the database.

Stock Price

The Stock Price edit box is a window on the database's stored value for the underlying stock's market price. If you change the stock price here, the new value will be saved in the stock definition when you change option symbols or quit the dialog. If you have the appropriate save confirmation preferences enabled, either of those actions will cause a confirmation dialog to post asking permission to update the database.

Risk Free Rate

The Risk Free Rate edit box displays the currently stored value for the risk free rate of interest. It's expressed as a percentage with a default value of 3%; here 4.76% is used. The risk free rate can be computed in the YieldCurveFitter (a separate tool) or you can set it manually here. It's a crucial quantity in valuing options, also used in numerous other NillaHedge tools. If you have created option positions and you want a realistic assessment of the value of those positions, you should always review and possibly modify the value of the risk free rate in the Option Analyzer, in one of the Explorer dialogs, or by using the Yield Curve Fitter prior to valuing any option positions.

Black-Scholes Value

The Black-Scholes value is discussed in the Glossary, so we won't review the details here – it's an analytical solution to option valuation that accounts for the current price for the underlying stock, its volatility, and the risk free rate of interest. Variations on the theme account for discrete dividends or model dividends as a continuous yield. NillaHedge discounts the stock price with the present value of any dividends rather than resorting to a continuous yield approach. This seems to model market behavior more effectively than the continuous dividend yield model, especially for options with expirations less than one year.

Implied Volatility

Implied volatility is defined in the Glossary, so we won't delve deeply into it here, but briefly volatility represents the standard deviation of returns on the underlying stock over a year. Volatility is a crucial quantity used to assess option value and because of that role, it can be estimated given the other market conditions, namely the current value of the risk free rate, the current market price of the underlying stock, and the current market price of an option on that underlying stock. Volatility is best estimated using options which are at or near the money and not overly distant from expiration. Options that are far from the money and/or greater than a year from expiry tend to incorporate secondary risks not accounted for in nearer term, nearer the money options. Both situations usually result in pushing the implied volatility higher than stock returns warrant. It's relatively rare to see a near term volatility higher than longer term volatilities.

iV Pricing Error

Calculating implied volatility is an iterative process, which may fail to converge on a satisfactory solution. The degree to which a solution is satisfactory is given by the pricing error associated with the implied volatility. Ideally, this should be a vanishingly small number, as close to zero as possible. When the implied volatility pricing error is negative, it means that the implied volatility produced a market price lower than the specified market price for the option.

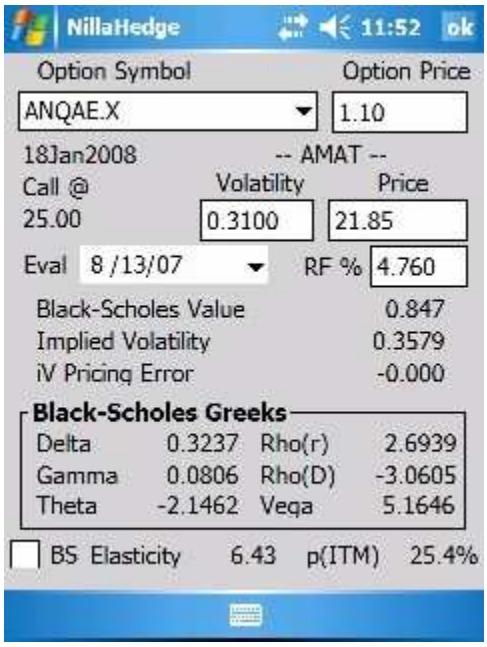
Conversely, when iV pricing error is positive, it means that the implied volatility produced a market price above the specified market price.

When the option is 'rationally' priced, implied volatility will generally converge and produce little or no pricing error. So pricing error can be an indication that options are incorrectly priced. The only way to know for sure is to look at the relationship between put and call prices at the same strike. The market is correctly pricing options when the following relationship holds: $C - P = S - K$, or more accurately $C - P = S - pv(K)$, where C is the call price, P is the put price, S is the stock price, and $pv(K) = Ke^{-r(T-t)}$ is the present value of the common strike of the put and the call, where $T - t$ is the time to expiry in years. A deviation from equality is an indication that an arbitrage opportunity exists.

Unfortunately, irrational prices aren't the only situation that might prevent convergence. When the time to expiry is relatively short and the option is at or near the money (the underlying stock price is very close to the option's strike price) the volatility surface will be very steep, so implied volatility will have difficulty settling. The implied volatility calculator detects situations involving mispricing and instability and bails out early, indicating the smallest pricing error found among the volatilities tested. It doesn't communicate why it bailed out, but if expiry isn't near at hand and the option is not near the money, you should consider the possibility that the current option price represents an arbitrage opportunity. Black-Scholes isn't a perfect model of market behavior – some researchers have estimated that options prices vs. their associated Black-Scholes value typically differ by 2% or more, but an implied volatility pricing error greater than that should definitely cast doubt on the implied volatility reported. We considered simply clearing the volatility or reporting "~" in these cases and not bothering to report the pricing error at all, but ultimately decided to keep the user in the loop, since the 2% figure itself is somewhat open to debate.

Black-Scholes Greeks

Briefly, the Black-Scholes greeks indicate the option's sensitivity to changes in the risk free rate (*rho*(*r*)), the passage of time (*theta*), as well as the underlying stock price (*delta*), dividends (*rho*(*D*)), and volatility (*vega*). Derivative information includes *gamma*, *elasticity*, and the probability of closing In-The-Money (*p*(*ITM*)). Each of the Black-Scholes greeks and derived quantities are discussed in the Glossary.



BS CheckBox

The BS (for Black-Scholes) check box in the lower left corner allows you to see what elasticity would be if scaled by the option's market price (unchecked), rather than its Black-Scholes value (checked). It is always checked when the OptionAnalyzer is first posted since that represents the true expression for elasticity. In this example, the gap between market price and Black-Scholes

value is substantial, so the elasticity also changes substantially.

Black-Scholes Shortcomings

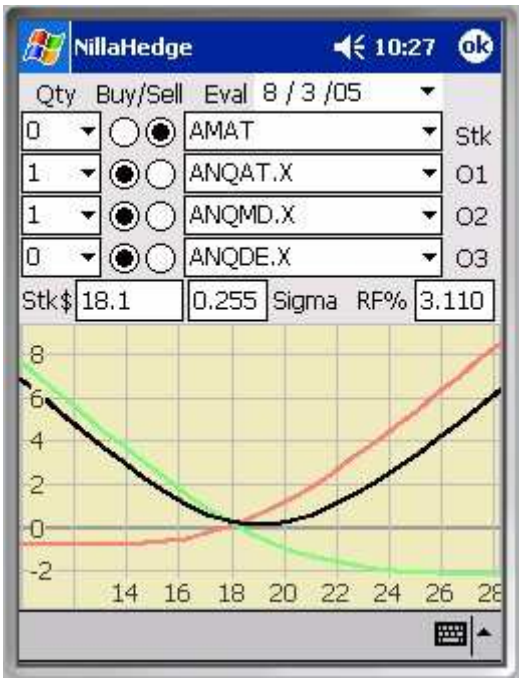
It is quite unusual for such a large gap to exist between the market value and the Black-Scholes value for an option with only four months to expiry. In this example, you get the same valuation whether Applied Material's $0.11 dividend (with ex-dividend date 14 August 2007) is entered in the Stock Definition or not, but this is just one potential source of valuation error. We addressed volatility mispricing earlier – note that *vega* is substantial here, so under or over-estimating of the volatility in a small way will produce large deviations away from the option's 'true' market value. At this point in time, Applied Materials has almost doubled in price in twelve months, so opinions regarding its volatility tend to run towards the high side.

Early Exercise Premium

Another source of error is built into Black-Scholes itself – it derives from the fact that Black-Scholes assumes that options can only be converted to stock or cash on the option's expiration date, so called European style options. In contrast, traded options generally allow for exercise on any date up to and including the expiration date, so called American style options. In efficient markets, it is generally suboptimal to early exercise a call, but puts on underlying stocks that don't pay dividends can deviate sufficiently from the Black-Scholes value to make early exercise a good bet (capture profits now with relatively low risk of the underlying stock dropping further than the time value of money now invested elsewhere. Over a short period, this is likely to be a very small premium, but it grows with distance from expiry. Unfortunately, there is no closed form solution for the early exercise premium with an arbitrary exercise date. Closed form solutions exist for what are called Bermudan style options – options that can be exercised on one of several dates specified in the contract. Assessing the premium typically requires a multivariate combination of Bermudan valuations or a much more time consuming binomial expansion - a sort of discrete time approximation that produces better and better accuracy as the binomial tree populates price-time space. Trading firms with massive computer power evaluate as many as 10,000 node binomial trees in order to accurately determine option value, including any early exercise premium. Therefore, it should not surprise you to find market prices in excess of the Black-Scholes value, but Black-Scholes establishes a very reasonable low water mark, what might be considered to be the option's blue book value (assuming you got the volatility right). As you gain experience, you will get a sense for how the early exercise premium scales with time to expiry.

Graphical Tools

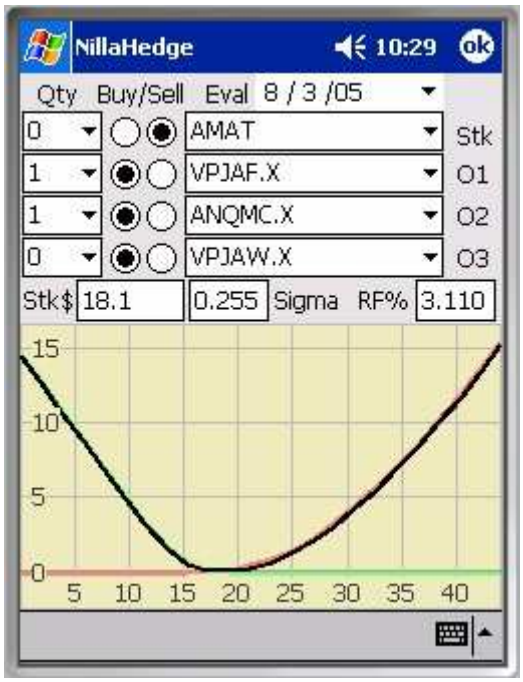
Hedge Explorer



The Hedge Explorer provides a graphical environment in which option spreads and hedges can be evaluated. The Hedge Explorer supports analyzing strategies involving up to three different options and their underlying stock. The quantity of each issue is user-specified, so the Hedge Explorer inherently supports 'ratio spreads,' where the quantities can take on values other than 0 or 1.

Applied Materials (AMAT) has 50 calls and 50 puts. If you downloaded all of them in the OptionChainRetriever, how many spreads can you construct in HedgeExplorer? If you select a different symbol for O1, O2, and O3, there are $\frac{100!}{(3!)(97!)} =$ 161,700 unique combinations, not including variations you can introduce by adding stock to the mix, modifying your buy/sell strategy, or using quantities other than 1. The point is … as much fun as it might be to scan through the profit profiles of possible option spreads, watching plots flash on the screen, it's just not practical to manually review every possibility. However, a little planning will go a long way to reducing the number of alternatives worth considering.

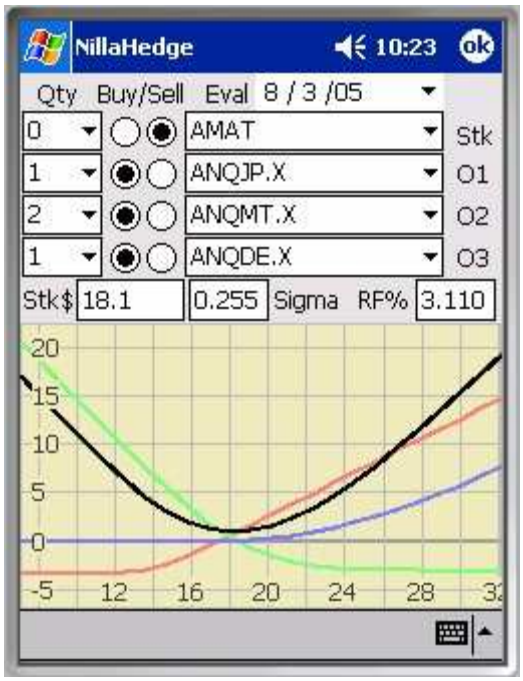
The Plot



Hedge Explorer plots show stock prices along the X-axis and profit (loss) along the Y-axis. The colors assigned to option symbols are red, green, and blue ordered from topmost symbol to bottom (e.g. VPJAF.X – red, ANQMC.X – green, etc. in the screenshot at right). A stock position will plot in purple. When two or more issues have nonzero quantities, the sum of the positions is displayed in black. The curves are plotted in the following order: red, green, blue, purple, black.

To illustrate, we'll explore a few examples. The two options contributing to the spread above right are (in red) ANQAT.X, an 20-Jan-06 Call struck at $19; and (in green) ANQMD.X, a 20-Jan-06 Put struck at $20). ANQAT.X is selling for $0.80 and ANQMD.X is selling for $2.20, so it would cost $300 plus fees to place this bet. This combination of options is known as

a vertical (both options expire on the same date) long strangle (nearly a straddle). If AMAT moves up to $22 before much time passes, the position produces a $100 profit, at $27, it turns into a $500 profit.



Players on a tight budget might be happier with the spread at right. The two options contributing to this spread are (in red) VPJAF.X, a 19-Jan-07 Call struck at $30; and (in green) ANQMC.X, a 20-Jan-06 Put struck at $15). VPJAF.X is selling for $0.15 and ANQMC.X is selling for $0.20, so it would cost $35 plus fees to place this bet. The call expires a year later than the put, so upside profit potential is available for an additional year. This long strangle calendar spread is optimal when you're long term bullish, but have some bearish reservations for the short term. It yields ~$240 at $27; AMAT needs to hit $32 to produce a $500 profit. As expiry approaches, much of the lift in the options will have eroded away due to time-decay. You can explore this effect in the Time Decay Explorer or by modifying the evaluation date.

If you can flash more cash, you could consider the spread at left. ANQJP.X is a 21-Oct-05 Call struck at $14, ANQMT.X is a 20-Jan-06 Put struck at $19, and ANQDE.X is a 21-Apr-06 Call struck at $25. ANQJP.X is selling for $3.40, ANQMT.X is selling for $1.55, and ANQDE.X is selling for $0.15, i.e. the position would cost $665 plus fees. In this case, AMAT need only move up to $24 to produce a $5+ profit per option.

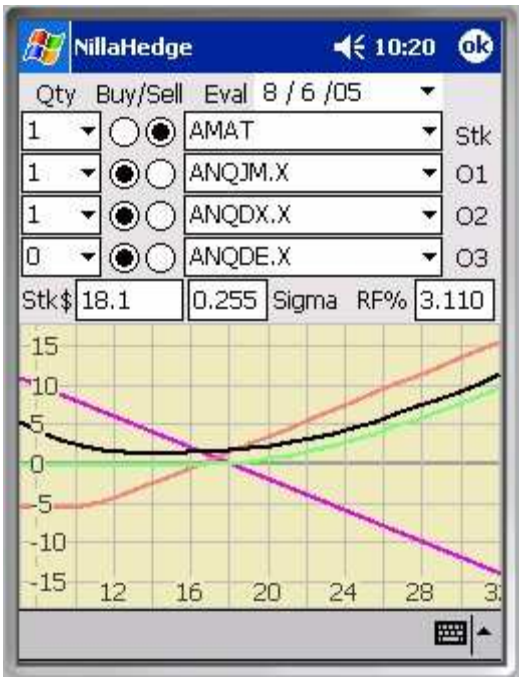
Since this is a calendar spread, it's useful to consider how the position behaves when the upside heavy lifter (ANQJP.X) expires. In the screenshot at right, the evaluation date has been moved up to 21-Oct-05 … ANQJP.X has flat-lined so the most likely portion of the upside is now under water.

If you have a taste for arbitrage, you could play the options and stock markets against each other. In the screenshot at left, ANQJM.X is a 21-Oct-05 Call struck at $11, selling for $5.5 and ANQDX.X is a 21-Apr-05 Call struck at $22.5, selling for $0.25. The short sale of AMAT produces $1810 (less transaction fees) - more than enough to finance the purchase of ANQJM.X and ANQDX.X for $575 (plus fees). Presuming that trading costs won't erode the $1.25 or so in per share profits, you should sell as many blocks of AMAT as you can hedge with purchases of ANQJM.X and ANQDX.X.

Now that you've seen a few ways to find a profitable position in the Hedge Explorer, we can address the operational details.

Stock Symbol (Stk)

The Stock Symbol combo-box (to the left of the label 'Stk') allows you to enter or select a stock symbol from a drop-down list. Upon picking a stock, option symbols for that stock are loaded into the option symbol combo-boxes, so you are always selecting options drawn on that underlying. To plot, the Stock Qty must be nonzero and its Buy or Sell button must be selected.



Option Symbols (O1, O2, O3)

Option Symbol combo-boxes allow you to select an option symbol from the drop-down list or type a few letters and let auto-completion find an option symbol for you. To see a plot of an option's profit (loss) line, the associated Qty must be nonzero and its Buy or Sell button must be selected.

Quantities (Qty)

These edit boxes specify non-negative floating point quantities of the Stock or Option symbol to the right. '1' represents a single share or option, not a block of 100 shares or a contract with 100 options. Don't get too caught up in the magnitudes - for analytical purposes the ratios between the quantities are more important.

Buy/Sell Buttons

Initially in an undefined state, once selected, the Buy/Sell buttons subsequently act as radio buttons, selecting one, deselects its opposite.

Evaluation Date (Eval Date)

The Eval Date picker drives the time to expiry of the options enabled in the plot. It is initialized to the present date, but you can modify the evaluation date to see how the profit (loss) curves look at other points in time.

Stock Price (Stk$)

The stock price is loaded from the database when a stock symbol is selected, so you can see and modify it. The Hedge Explorer adopts the Confirm Save Preferences of Analyzer Dialogs, so the Hedge Explorer may ask permission before updating the stock's market price or do so silently, based on the state of 'Analyzer dialogs – close' preference.

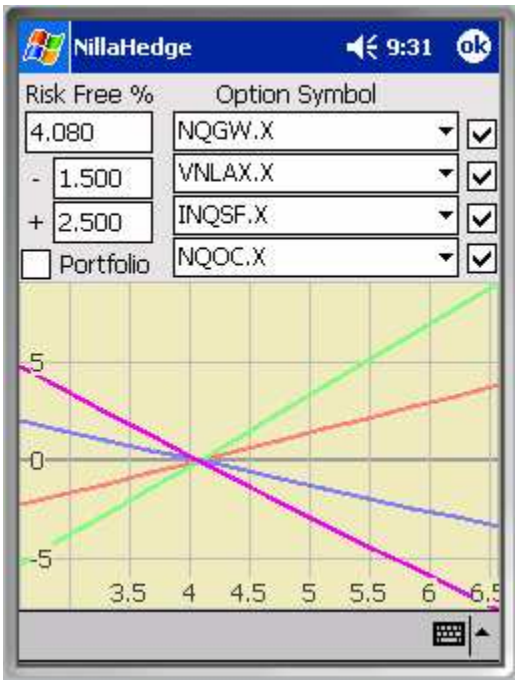
Volatility (Sigma)

The stock's volatility is loaded from the database when a stock symbol is selected, so you can see and modify it. The Hedge Explorer adopts the Confirm Save Preferences of Analyzer Dialogs so it will ask permission before updating the stock's volatility if 'Analyzer dialogs – close' preference is checked.

Risk Free Rate (RF%)

The Hedge Explorer loads the currently stored value and displays it as a percentage. Changing the value in the edit box will force a redraw with the new value, but the global risk free rate won't be updated until the HedgeExplorer closes. At that time, the stored value of the risk free rate is updated silently.

Rate Sensitivity Explorer



The Rate Sensitivity Explorer provides a graphical view of how options behave when interest rates change. After gaining some familiarity with the Rate Sensitivity Explorer, you'll probably discover that call options (NQGW.X & VNLAX.X) increase in value when interest rates rise, while put options (INQSF.X & NQOC.X) gain value as rates fall.

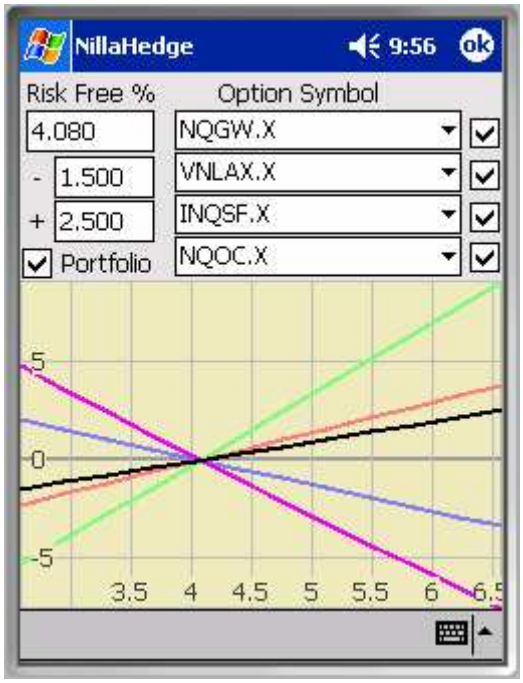
The Plot

The X-axis depicts prospective risk free rates of interest, so all curves will pass through (rfr, 0). The Y-axis depicts the percentage change in the value of the issue (or portfolio) at each X-value. The colors assigned to the curves are red, green, blue, and purple ordered from topmost symbol to bottom, e.g. NQGW.X – red, VNLAX.X – green, etc. as shown in the screenshot at left.

Plot Enabling Checkboxes

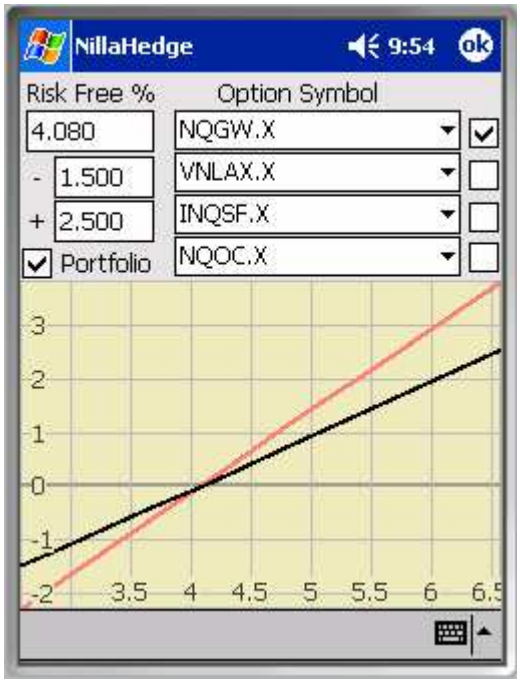
The four checkboxes on the right side of the dialog control whether the option symbol currently displayed in the adjacent combo-box will be plotted. They're all enabled in this example to facilitate comparing the rate sensitivity of the selected options to that of the portfolio as a whole.

Portfolio



Positions must exist in the portfolio for the Portfolio checkbox to be enabled. When enabled and the checkbox is checked, an additional curve is plotted in black, representing the cost weighted average of the rate sensitivity of all option positions in the portfolio.

In the second example, the interest rate sensitivity of the portfolio is relatively low. If your interest is in getting a better view of the rate sensitivity of the portfolio, you can disable some of the more rate sensitive options and the plot will rescale to fill the vertical extent of the plot area. In the example below, VNLAX.X, INQSF.X, and NQOC.X have been disabled. It's now apparent that the option portfolio will increase in value by 2% if the risk free rate rises from its current 4.08% to 6%.



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%.

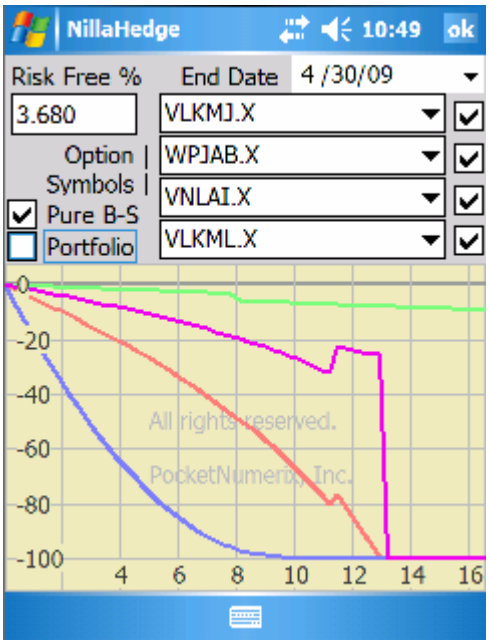
'-' Edit Box

The '-' edit box specifies how far below the current risk free rate to set the low X-value in the plot. This value cannot exceed the risk free rate.

'+' Edit Box

The '+' edit box specifies how far above the current risk free rate to set the high X-value in the plot.

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.

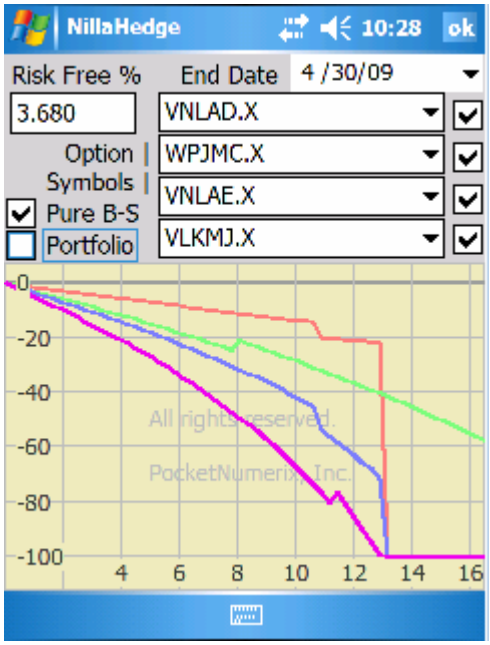
The Time Decay Explorer uses the most accurate approach available for computing Black-Scholes value and consequently is by far the most computationnally intensive analysis in NillaHedge. That computational complexity derives from the need to compute the present value of each potential dividend from the 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%.

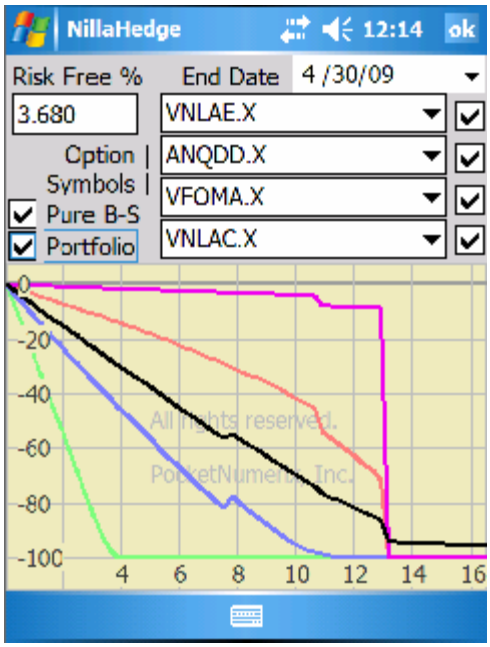
End Date

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

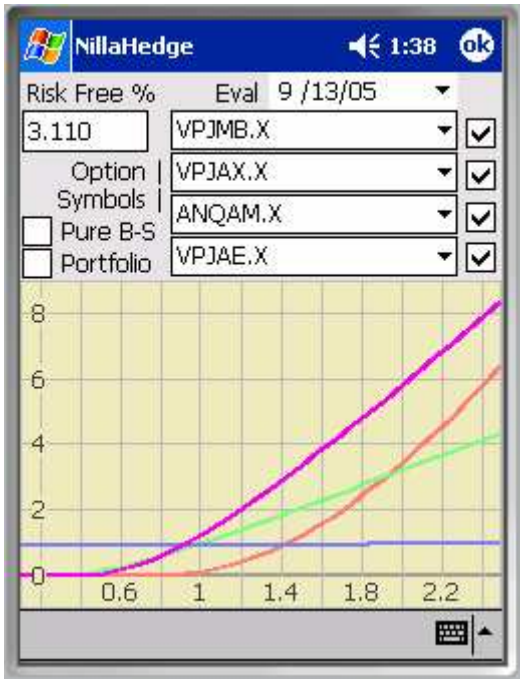
Options obviously decay in value over time - some gradually, others abruptly. It therefore behooves you to be aware of how your options portfolio behaves so you won't be caught unaware when a precipitous change in value is imminent. Secondarily, switching between Pure B-S and market price mode can shed 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.

Volatility-Value Explorer

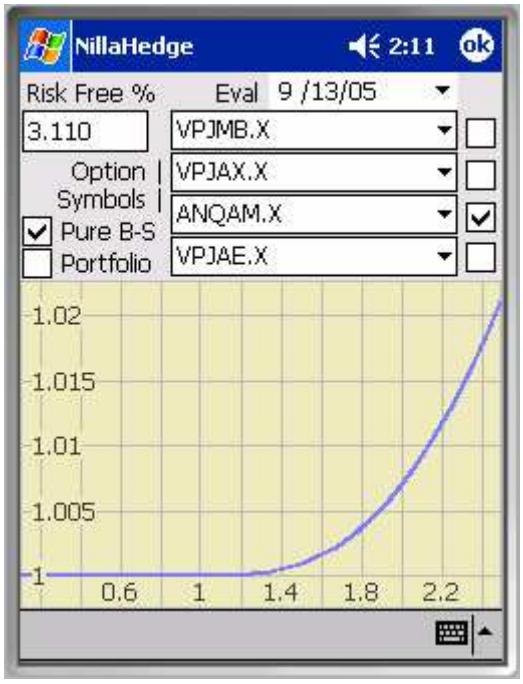
The Volatility-Value Explorer provides a graphical view of the relative sensitivity of options to their underlying stock's volatility. Up to four options can be compared simultaneously. The Volatility-Value Explorer has two modes of operation (really just ways to scale the Y-values), pure Black-Scholes and market price relative. In Pure Black-Scholes mode, the option's current market price is ignored - only the risk free rate and the underlying stock's price and volatility influence the plots. When the Pure B-S check box is unchecked, the option's last known market price becomes the reference against which imputed option prices are scaled.



The Plot

The first thing to remember about volatility-value plots is that both axes depict *ratios*, not volatilities, option value, or percentages thereof. The horizontal axis depicts the ratio of experimental volatility to the current volatility for the option's underlying stock, so $x=1$ represents the currently stored volatility for the underlying stock. The vertical axis similarly depicts the ratio of the imputed Black-Scholes value to the option's last known market price or its Black-Scholes value (depending on the state of the Pure B-S checkbox), so $y=1$ represents the option's relative value at a given relative volatility.

The colors assigned to option symbols are red, green, blue, and purple ordered from topmost symbol to bottom (e.g. VPJMB.X – red, VPJAX.X – green, etc.). When option positions exist in the database, the Portfolio checkbox will be enabled. When checked, a black line depicts the volatility-value curve for the current option portfolio with each option's contribution weighted by the cost of the associated positions (refer to the screenshot below).



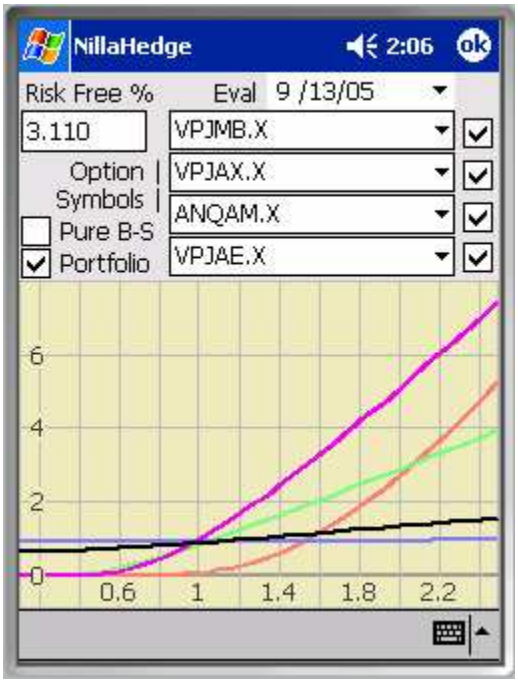
Plot Enabling Checkboxes

The checkboxes on the right side of the dialog enable/disable plotting the volatility-value for the option symbol immediately to its left. When options produce very high value-volatility ratios while others are less responsive, it can be difficult to assess the behavior of the low ratio options. In that case, you can disable (uncheck) the high ratio options, triggering the

plot to re-scale to accommodate the remaining curves, thus providing more insight into the low ratio options' behavior. Compare the first Volatility-Value Explorer plot with the one at right.

Pure Black-Scholes mode

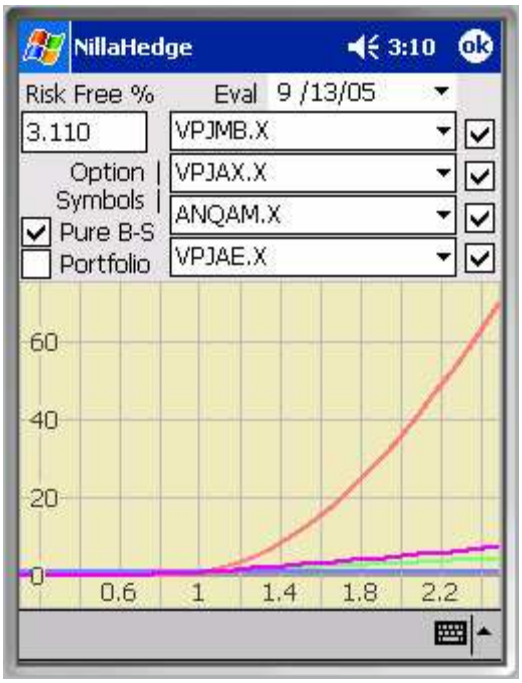
When Pure B-S is checked, the plot represents the imputed option value divided by the Black-Scholes value at the reference (underlying stock's stored) volatility, consequently the volatility-value curves all pass through $(x, y) = (1,1)$. In market price mode (Pure B-S is unchecked), the Y-values in the plot represent the imputed option values divided by the option's stored market price, so the volatility-value curve can pass above or below $(1,1)$.



All things being equal, a premium option, whose currently stored market price exceeds its Black-Scholes value at the currently stored volatility, will pass below $(1,1)$ as VPJMB.X (red) does in the screenshot at right. Conversely, a bargain option, whose Black-Scholes value at the currently stored volatility is greater than the option's currently stored market price will pass above $(1,1)$ as VPJAE.X (purple) does.

Portfolio

The Portfolio check box enables you to see how your entire option portfolio is positioned with respect to volatility risk relative to the currently stored volatility for the underlying stock. The Volatility-Value Explorer plots a curve which sums all option positions in your portfolio, each option's contribution to the volatility-value curve being weighted by the cost of the position relative to the total cost of the option positions in the portfolio. It's unchecked at right to better show the volatility-value curves for ANQAM.X and VPJAX.X.



Evaluation Date

The Evaluation Date picker defaults to the current date, but can be set earlier or later to review how current parameters would affect volatility-value in the past or future.

Risk Free Rate

The Risk Free Rate edit box displays the currently stored value for the risk free rate. It's expressed as a

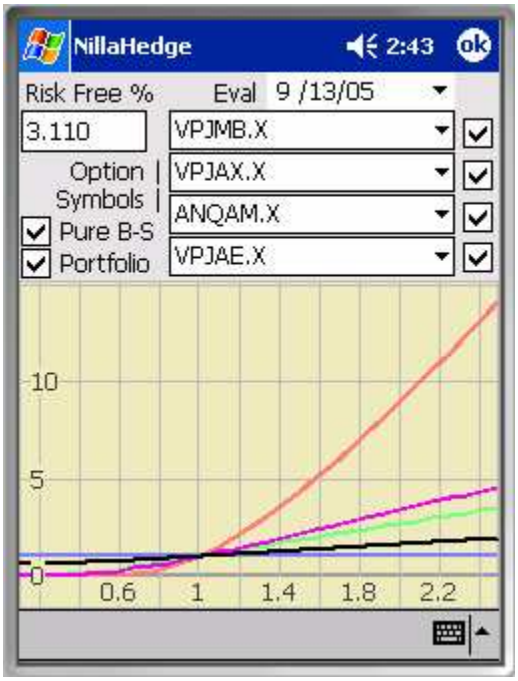
percentage with a default value of 3%.

Volatility Risk

Volatility risk has been a key factor in the financial difficulties at Barings Bank and at Long Term Capital Management, so it's an issue of very real concern to professional portfolio managers. Accurately hedging against volatility risk is a complex topic beyond the scope of NillaHedge and this documentation, but the Volatility-Value Explorer does help you to quantify relative volatility risk, enabling you to make more informed choices.

The thing to remember about using the Volatility-Value Explorer is that is depicts what happens to option prices as a function of relatively heavy-handed modifications to the underlying stock's volatility. An assumption in analyses of this sort is that the reference volatility is 'reasonable,' but it becomes a critical assumption when attempting to assess relative volatility risk between options not drawn on the same underlying stock.

The Volatility Smile

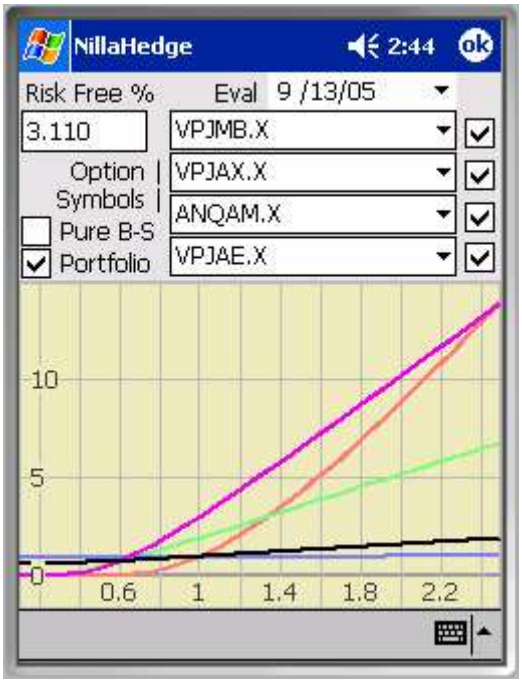


If you are not already familiar with the volatility smile, it is a curve that results from plotting implied volatilities against strike price, with implied volatility increasing as the strike distances itself from the underlying stock price. In fact, the smile is really a surface. If you examine implied volatility versus time to maturity, you will note a similar effect. Part of the reason for non-constant implied volatility is that Black-Scholes theory assumes that stock returns are lognormally distributed, which means that the natural logarithm of stock returns is normally distributed. The lognormal assumption is attractive because it's close to reality and analytically tractable, but historical returns show that the actual distribution has somewhat fatter tails and a higher peak at the mean.

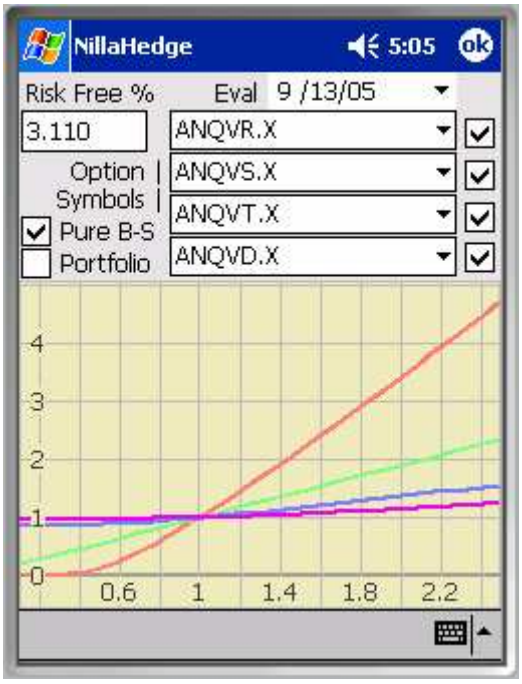
So, volatility risk intuition is potentially clouded by the volatility smile and our imperfect understanding of how to compare apples and oranges, e.g. AMAT to INTC, etc. Both potential problems are ameliorated by scoping your comparisons to options in the same neighborhood with respect to expiration and moneyness (degree to which the underlying stock's price is into the option's profitable zone).

After using the Volatility-Value Explorer for a few minutes, you'll surely notice that low value, high implied volatility options are much more likely to produce high option price ratios for a given multiple of volatility than those with higher intrinsic value, as illustrated by VPJMB.X in the previous four screenshots. VPJMB.X is a Jan-07 Put with a $10 strike selling for $0.15 while its underlying stock (AMAT) has a market value of $17.97.

It's wise to review the volatilities assigned to stocks underlying any options of interest before comparing the volatility-value ratios of the associated options. Without venturing outside of the family of options on Applied Materials (AMAT), note that the second pair of plots in the Volatility-Value Explorer section used a reference volatility of 0.231 (nearly VPJAE.X's implied volatility), causing VPJMB.X (red) to appear to be selling at a high premium and producing vastly different volatility-value ratios in Pure B-S and market price modes. In the next pair of plots in this section, the reference volatility is the implied volatility for VPJMB.X ($\sigma = 0.3553$), so VPJMB.X now passes through $(1,1)$ in market price mode and behaves identically in both modes. Unfortunately, VPJAE.X (purple) now appears to be a bargain option, demonstrating a similar Jekyl-Hyde schizophrenia when switching between Pure B-S and market price modes because it feels mispriced. You may also note that VPJAX.X (implied $\sigma = 0.2479$), which previously passed near $(1,1)$ now appears to be a bargain option because the reference volatility is so much higher than its implied volatility.



Alternatively, in the plot below right, we have four puts all expiring in Oct05 with ANQVR.X (implied $\sigma = 0.236$) struck out-of-the-money at \$17, ANQVS.X (implied $\sigma = 0.2572$) struck slightly in-the-money at \$18, ANQVT (implied $\sigma = 0.275$) struck at \$19, and ANQVD.X (implied $\sigma = 0.088$) struck at \$20, while AMAT has a market value of \$17.83. Certainly, we've come to expect that out-of-the-money options exhibit higher volatility sensitivity, but since I mentioned them, the question you might really want to ask is "What's up with ANQVD.X's implied volatility?" The first thing of note is its extremely low *vega* = 0.0011, while its temporal brethren have *vega*s on the interval [1.78 .. 2.29), but perhaps more to the point, its *delta* = -1.0 and consequently its probability of closing in-the-money is 100%, meaning that other factor sensitivities, including volatility, are not particularly influential at the current stock price.



One conclusion you might draw from the foregoing discussion is that you should always have a good understanding of what you're looking at in the Volatility-Value Explorer, but I hope the walk away benefit will be your recognition of the degree to which volatility can drive option value, so you

won't enter positions without assessing the risks and grappling with the model parameters beforehand.

Compensating Volatilities

One technique that partially compensates for inaccuracies introduced by the lognormal assumption is to use an Exponentially Weighted Moving Average (EWMA) to compute the underlying stock trend and volatility. J.P. Morgan's RiskMetrics group produces well regarded Value-at-Risk assessments using lognormal models in conjunction with EWMA volatilities. In Risk Management, A Practical Guide,[7] Alan Laubsch recommends using decay factor $\lambda = 0.94$. Using that decay factor, 75 trading days (105 calendar days) capture 99% of an exponentially weighted average, so the usual recommendation is to collect 80 trading days (112 calendar days) of stock returns. On-line sources leave something to be desired in this realm, but Carol Alexander's (2001) Market Models provides very accessible coverage of volatility, exponentially weighted moving averages, and other models used in portfolio management, without sacrificing any details. Given a set of daily returns, the volatility at time *t* (σ_t) is given by: $\sigma_t = \sqrt{(1-\lambda)\sum_{j=1}^{\infty} \lambda^{j-1} r_{t-j}^2}$, where r_{t-j} are the daily returns. Nobody has an infinite supply of daily returns, but with $\lambda = 0.94$, the influence of four month and older stock returns have negligible influence on the value of the sum anyway. After establishing a starting point EWMA estimate of the historical volatility, you can adopt a recursive model, e.g. $\hat{\sigma}_t = \sqrt{(1-\lambda) r_{t-1}^2 + \lambda \hat{\sigma}_{t-1}^2}$. Such EWMA volatilities partially compensate for the mismatch between actual stock returns and lognormal models, and the testimonial is how extensively RiskMetrics' approach is used by banks to model their portfolio risk and compute reserve requirements. If you plan to use a volatility that differs markedly from the RiskMetrics' model discussed here, you should know why.

[7] http://www.wu-wien.ac.at/banking/sbwl/lvs_ss/vk4/rmguide.pdf

Glossary

Black-Scholes Greeks & Elasticity

All of the variables used on the right hand sides below are defined in the glossary entry for the Black-Scholes value presented immediately after the greeks. The first derivative of the standardized cumulative Normal distribution, expressed as $N'(x)$, occurs frequently below - it's defined in a Glossary entry for the Normal distribution. In all cases, the values reported for the Black-Scholes greeks in NillaHedge are annual values. For simplicity's sake, all of the expressions for the greeks below are based on a continuous dividend yield Black-Scholes model. However, the Option Analyzer relies primarily on a present value dividends model (not presented in the glossary entries below) and only falls back to the continuous model in rare situations where the present value model can't be evaluated.

Delta

Delta measures the option's sensitivity to the underlying stock's price. When the investment objective is to hedge a stock position against risk, investors typically seek to maintain what's called a delta neutral position. That's accomplished by selling Δ shares of the underlying stock for each option you own. Of course, as the stock price changes, it will rapidly become apparent that this is a moving target, hence the interest in gamma. See also: Elasticity.

Calls: $\Delta = e^{-D(T-t)}N(d_1)$

Puts: $\Delta = e^{-D(T-t)}\left(N(d_1)-1\right)$

Elasticity

An option's elasticity is the option's delta scaled into the relevant currency, i.e. $\omega = \Delta\frac{S}{V}$, where *V* is the option's Black-Scholes value and S is the underlying stock's price. Elasticity indicates how much movement you can expect in the option's value given a change in the underlying stock's price, e.g. a call selling for $2.00 with $\Delta = 0.4$ on an underlying stock selling for $30 has elasticity, $\omega = 0.4 \cdot \frac{30}{2} = 6$, so a 1% increase in the stock price justifies a 6 % increase in the market value of the call. Puts generally have negative elasticity since changes in put values run counter to movements in the price of the underlying stock.

Gamma

Gamma measures the rate of change in delta with respect to the underlying stock's price. If you want to maintain a delta neutral position in a given stock, an option with high gamma will have to be re-hedged more often than one with low gamma, thus potentially costing you more in transaction fees. Skilled hedge investors try to find two or more options on the same underlying stock with counterbalancing gammas, thereby constructing a (near) gamma neutral position which will thereby minimize the need to re-hedge in response to movements in the stock price.

Puts & Calls: $\Gamma = \frac{e^{-D(T-t)}N'(d_1)}{\sigma S\sqrt{T-t}}$

Rho(D)

Rho(D) is the option's price sensitivity to changes in the underlying stock's dividends.

Calls: $\rho_D = -S(T-t)e^{-D(T-t)}N(d_1)$

Puts: $\rho_D = S(T-t)e^{-D(T-t)}N(-d_1)$

Rho(r)

Rho(r) is the option's price sensitivity to changes in the risk free rate.

Calls: $\rho_r = K(T-t)e^{-r(T-t)}N(d_2)$

Puts: $\rho_r = -K(T-t)e^{-r(T-t)}N(-d_2)$

Note: Most systems don't distinguish between rate sensitivities, reporting only something vaguely called *rho*. NillaHedge's ρ_r is probably the equivalent of other systems' *rho*.

Theta

Theta measures the option's price sensitivity with respect to the passage of time (*t*).

Calls: $\Theta = -\frac{\sigma S e^{-D(T-t)}N'(d_1)}{2\sqrt{T-t}} + DSN(d_1)e^{-D(T-t)} - rKe^{-r(T-t)}N(d_2)$

Puts: $\Theta = -\frac{\sigma S e^{-D(T-t)}N'(-d_1)}{2\sqrt{T-t}} - DSN(-d_1)e^{-D(T-t)} + rKe^{-r(T-t)}N(-d_2)$

John Hull and Paul Wilmott each give the expression above for theta, the first derivative of option value with respect to time, and I concur. Please do not be misled by Henry Tang's derivation.[8] Tang skips over a number of 'trivial' steps in his derivation of theta for a vanilla call and loses track of the continuous dividend yield discounting factor ($e^{-D(T-t)}$) in the first term. If you decide to embark on a derivation of your own, you'll quickly find that the last two terms fall straight out of the product rule, but you may initially scratch your head on how to convert (for a call) $Se^{-D(T-t)}N'(d_1)\frac{\partial d_1}{\partial t} - E\,\mathrm{e}^{-r(T-t)}\,N'(d_2)\frac{\partial d_2}{\partial t}$ into the first term. A detailed derivation is beyond the scope of this documentation, but it should be obvious that $d_2 = d_1 - \sigma\sqrt{T-t}$ is key to the transformation. In particular, you'll need

[8] http://www.quantnotes.com/fundamentals/options/thegreeks-theta.htm

$N'(d_2) = N'(d_1)\frac{S}{K}\mathrm{e}^{(r-D)(T-t)}$. Don't bother differentiating d_1 and d_2; just knowing $\frac{\partial d_1}{\partial t} - \frac{\partial d_2}{\partial t} = \frac{-\sigma}{2\sqrt{T-t}}$ is enough. Good luck!

Vega

Vega measures the option's price sensitivity to changes in the underlying stock's volatility.

Puts & Calls: $\nu = S\sqrt{T-t}N'(d_1)e^{-D(T-t)}$

Black-Scholes Value

There are a number of formulae that express the Black-Scholes value for an option. Many commonly assume that there are no dividends, so the term $e^{-D(T-t)} \to 1$, effectively making it disappear and simplifying the expression for the Put and Call values. The expression below is more accurate than tossing the dividends out the window, but it's not perfect because the continuous yield model accounts for dividends on the underlying stock even in situations where the ex-dividend date is after the option's expiration date. Real option prices respond to dividends whose ex-dividend date lands between the present time and the option's expiration date. NillaHedge uses the present value of discrete dividends where possible rather than averaging the dividend spikes through the calendar year as defined in the expressions below.

Early on, The Time Decay Explorer (TDX) always used the continuous model, but the plotting architecture now allows it to apply the present value model wherever it can be evaluated, hence the discontinuities in TDX plots when dividends are defined in the underlying stock. Given the low likelihood that you'd ever come across a discrete dividend version of Black-Scholes, we've only presented the continuous yield version here. The following expressions are discussed in several books authored by Paul Wilmott, as well as one by John Hull, among others. Don't be put off by the *N(x)* expression below - it's just the standardized (zero mean with a standard deviation of one) cumulative Normal distribution, discussed later in the Glossary.

$$C = S \cdot e^{-D(T-t)}N(d_1) - K \cdot e^{-r(T-t)}N(d_2)$$

$$P = -S \cdot e^{-D(T-t)}N(-d_1) + K \cdot e^{-r(T-t)}N(-d_2)$$

$$d_1 = \frac{\ln(S/K) + (r - D + 0.5\sigma^2)(T-t)}{\sigma\sqrt{T-t}}$$

$$d_2 = d_1 - \sigma\sqrt{T-t}$$

$$N(x) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{x} e^{-0.5\phi^2}\,d\phi$$

C := call value
D := annualized dividend yield
K := strike price
P := put value
r := risk free rate
σ := stock volatility
S := stock price
t : = current date (years)
T := maturity date (years)

Normal Distribution

Assuming a standardized Normal distribution, the probability of an event occurring at or below *x* is given by:

$$N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-0.5\sigma^2} d\phi$$

The first derivative of the standardized cumulative Normal distribution is the probability density function for a standardized Normal distribution. The Normal p.d.f. turns up frequently in expressions for various Black-Scholes' greeks as $N'(x)$, defined as:

$$N'(x) = \frac{e^{-0.5x^2}}{\sqrt{2\pi}} \text{ rate s}$$

Probability of Closing In The Money, *p*(*cITM*)

The probability of closing In The Money is an indication of the likelihood of that the option will expire with the stock price above the strike if the option is a call; or below the strike price if the option is a put. This probability is a natural outgrowth of Black-Scholes pricing theory, discussed below.

Calls: $p(cITM) = N(d_2)$

Puts: $p(cITM) = 1 - N(d_2)$

Volatility

Volatility - a measure of the amount by which stock returns have fluctuated (historical volatility) or are expected to fluctuate (expected volatility) in the future. The volatility of a stock is the standard deviation of the continuously compounded rates of return over a specified period. It's equivalent to the standard deviation of the differences in the natural logarithms of the stock prices plus dividends, if any, over the period. Although the observation period may be less than a year or several years, by convention, volatility represents the standard deviation in the stock's annual returns. The higher the volatility, the more you can expect returns on the stock to vary. Volatility is sometimes quoted as a percentage, but in NillaHedge, it's not scaled up by 100. If you use volatility from a source that reports it as an annual percentage, be sure to scale it back down. An excellent source for volatility values (reported as percentages) is Robert's Historical Stock Volatilities.[9] An excerpt appears in the Resources section, near the end of the user manual.

[9] http://www.intrepid.com/~robertl/stock-vols1.html

Resources

Volatility Quotes

Robert's Historical Stock Volatilities[10] – Robert's will produce a report that looks something like the following table for Intel Corp.

Ticker	1 Month	2 Month	3 Month	6 Month	9 Month	1 Year	2 Year	3 Year	4 Year	5 Year
INTC	32.03%	27.95%	28.32%	33.74%	30.90%	30.67%	34.13%	46.46%	51.06%	62.57%

Obviously, there are many possible answers for a given stock's volatility, depending on your observation window. The situation is complicated by the fact that options typically incorporate investor's beliefs about the underlying stock's expected volatility. If you believe that a stock's returns will be less volatile than they have been historically, then the value of options on that underlying stock will be consequently less valuable. You can get a sense for what other investors believe the stock's expected volatility will be by looking at the volatility implied by current option prices on that stock. Even there, beware that implied volatility is generally not constant across all strike prices and expiration dates - you must still use your own judgment to interpret the implied volatilities observed.

[10] http://www.intrepid.com/~robertl/stock-vols1.html

References

[Hull] Options, Futures, and Other Derivatives, Fifth Edition

John C. Hull. 2002 Prentice Hall

This is an excellent reference on everything from interest rate markets, credit risk, hedging strategies, Black-Scholes theory, the greeks, volatility smiles, etc. Hull continues on into exotic options, interest rate derivatives, swaps, Value-at-Risk, using moving averages to compute volatilities, and more. Very little of Hull's book could be edited out without losing something valuable and Hull's section on spreads is much more useful than Wilmott's.

[Wilmott] Paul Wilmott Introduces Quantitative Finance

Paul Wilmott. 2001 John Wiley & Sons, Ltd.

Wilmott has written various books in the computational finance arena, one being a two-volume set (a greatly expanded version of this text), but in this particular text Wilmott and Hull seem to be competing head-on. While Hull and Wilmott each spend a chapter on binomial models, Monte-Carlo methods, value at risk, and credit risk, Wilmott extends that treatment with chapters on portfolio management, RiskMetrics, and CrashMetrics, though these issues are probably beyond the call for the typical NillaHedge user. Wilmott has probably over-diagramed this book - on a content per page basis, I'd pick Hull's book unless you need or want the chapters on portfolio theory, RiskMetrics, and CrashMetrics.

