Module 3

Volatility Analysis

Contents

Introduction & Objectives

This module will give you a greater insight into how shifting volatilities affect options premiums. This understanding is the cornerstone for finding trades and implementing optimum trading strategies.

After completing this module you will understand:

- How volatility affects option premium.
- Vega.
- Option fair value calculation.
- Implied volatility.
- How to read volatility charts.
- The mean reversion tendency.
- Percentile rankings.
- How to identify expensive and inexpensive options.
- How to identify overvalued and undervalued options.

Stock Price Volatility

The three most important factors for successful options trading are time, price, and volatility.

T x P x V

Time Price Volatility

This module examines implied volatility, which is probably the most overlooked and misunderstood aspect of options trading.

Imagine that the price chart of stock IYK shown below is an aerial view of a tract of land. Imagine a drunken person standing with a loaded rifle at location "A" aiming broadly in the direction towards "B". He is unsteady. His eyesight is not clear. The barrel sways from left to right. The safety catch is off. Where would you prefer to stand: "C" or "D"?

[Courtesy of OptionVue Systems]

Key Point

Options traders assess the chances of a stock price finishing in a future price range.

If you were to wager that the IYK stock price would cross above $60, given the same odds, would you choose target "C", three months away, or target "D" a year away? These decisions are the decisions options traders make every day. In the chart above it looks like the price has been reasonably steady since the beginning of 2005, confined to an 8% range between $51 and $55 for eighteen months. We can't know in advance if or when the price might break out of that range, but it seems that "C" has a lower chance of being hit than "D". Without other information we might guess that there would be a reasonably good chance that the price might be between $50 and $56 by the end of 2006. We might also guess that there would be a low chance of the price going above $60 before the end of 2006.

In this section of the course we are not so much concerned with the actual price forecast. We are concerned here with chance.

The Time Value of Chance

If you were to write a $60 call option over IYK stock, would you prefer it to expire in November 2006, four months away, or July 2007, a year away? Where would you be safer: "C" or "D"? Where would you prefer to stand? Remember if you write a call, you lose money if the stock price rises too high. As a writer you want the option to expire worthless, to keep the premium. You would want the stock price to remain below $60. Of course your answer would depend on the premium you receive for the risk you take.

Options writers assess risk, and they expect a premium which would satisfactorily reward them for the risk they take. An options writer would want more premium for a call option at "D" than at "C" because there is more time remaining until expiry, during which the stock price will fluctuate. Waiting nearly a whole year (until "D") increases the chance that the price will exceed $60, and that the holder will exercise the call option at the writer's expense. The longer you wait, the greater the chance of ending up in the money. This is another way to look at time decay, introduced in Module 1.

Key Point

The longer the time until expiration, the greater the option premium.

Stock Price Volatility

Options traders need to quantify risk in monetary terms. Without understanding the price of chance, it becomes difficult to decide whether to buy or to write, and which options to trade.

Compare the previous IYK example with the price chart of Pozen shown next.

[Courtesy of OptionVue Systems]

Key Point

More time until option expiry gives more chance for the underlying stock to reach the strike price, bringing the option "into the money".

Stock Price Volatility

The stock price is fluctuating wildly. It is traversing a range of more than 200% from $6 to over $18 and back down. Without other information, it is much more difficult to try to guess where the price might go in the future. The price is currently around $10. The price might go anywhere. It would be much more risky to write a $12 call option over Pozen stock, than a $60 call over the earlier more stable IYK stock.

But people do write call options over wildly fluctuating stock. Those options are available on the market. Why do people risk writing options over such highly volatile stock? They do so because they are rewarded with a high premium income. When the stock price fluctuates wildly, the premiums are very high. The risk is much higher that the options will end up in the money and then be exercised. Options writers are paid a higher premium for options over volatile stocks than for options over tight price range bound stocks.

We've now introduced two very important concepts.

Firstly: stock prices can have different levels of volatility. The Pozen stock price was highly volatile during the period shown. The stock price traversed a 200% range during an 18 month period. The IYK stock price was not very volatile. It only traversed an 8% range over the same period of time.

Secondly: volatility affects option premiums. Options writers would want a large premium for writing options over the highly volatile Pozen stock, because it seems likely the stock price could easily jump a long way from the current price. Options writers would not need to be compensated as much for taking risk on the less volatile IYK, because it seems less likely that the stock price will jump too far away from the current value. Options premiums are lower for low volatility underlying stocks. Premiums are high for high volatility underlying stocks.

We have shown above that two different stocks can have different levels of volatility. But the volatility of a stock can change with time. Any given stock might be more volatile at some times and less volatile at other times. Bollinger Bands on a price chart expand and contract with the volatility of the underlying stock price. When the stock price is moving about wildly the Bollinger Bands become wider. At other times, when the stock price is calm, the Bollinger Bands become narrower.

Skip the Mathematics?

We'll now describe exactly the same concept in a different manner. The reader can safely skip the following description if desired. For readers who are interested in the underlying mathematics, we describe the same concepts again below, this time from a mathematical viewpoint.

Key Point

Option writers are paid a high premium for writing options over highly volatile stock.

Volatility makes it more difficult to predict a future price.

How Volatility Affects Premium

We learnt in Module 1 that an option premium consists of two components: time value and intrinsic value. We now reconsider time value in terms of volatility. The IYK chart is shown again below, but overlaid is a bell curve which represents the chance that the IYK stock price will be at a certain price at the vertical solid line, in September 2006.

The curve at the right shows that there is a very high chance the price will continue along the channel to finish somewhere around $51-$55 in September, 2006. There is a lower chance that the price will deviate too far away from that range. Importantly there is a low chance that IYK will reach $60 by September 2006. We would expect the premium for a $60 September call to be low.

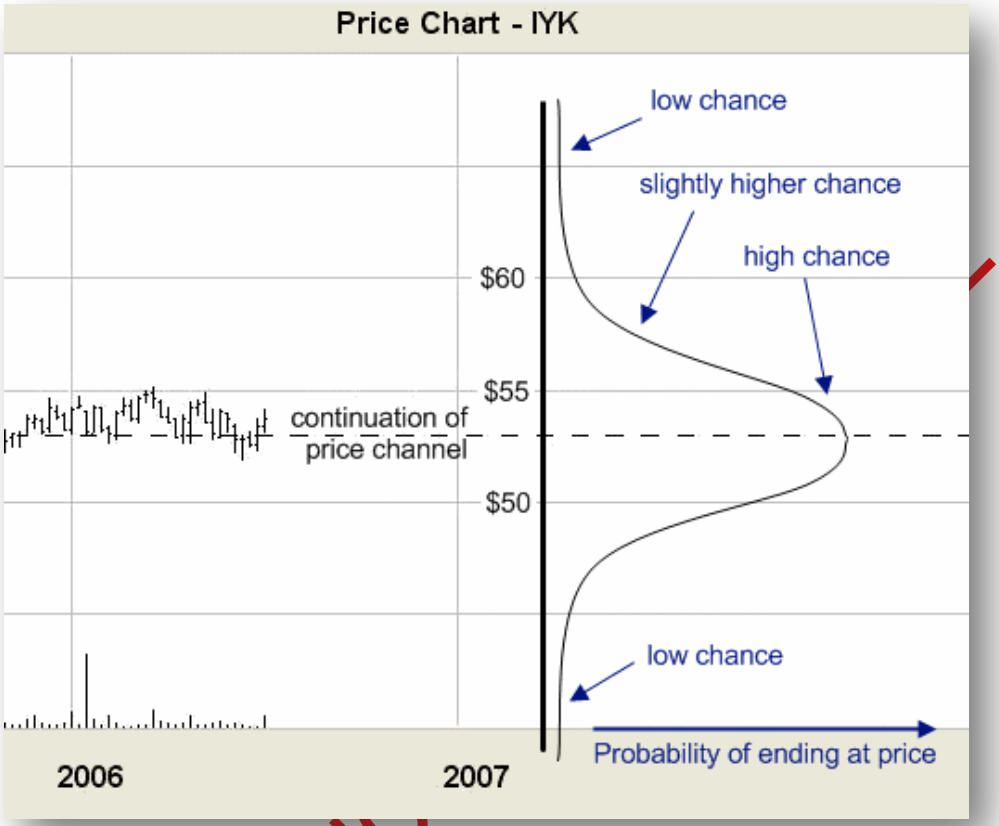
But if we allow more time and go further into the future there is a greater chance that the price will reach $60. The chances of reaching any price become distributed more flatly over a wider price range, as shown in the next diagram. The bell curve flattens and becomes wider. There is a greater possibility that the price will deviate further away from the $51-$55 range.

The time value of the option is related to the chance that the option will be in the money at expiry. The time value of the $60 call option is related to the chance that the stock price will be above $60 at expiry. The time value is therefore related to the area under the bell curve above $60.

Key Point

There is a high chance that a price will finish close to its current value. There is a lower chance that the price will wander further away.

How Volatility Affects Premium



With more time until expiry the chance of the stock price ending up above $60 in mid-2007 is now higher than before. There is more time available for the price to wander. The bell curve is flatter and broader. As the bell curve flattens, the chance increases that the price will finish above $60. The area under the bell curve above $60 increases. That's why options premiums are higher when expiry is further away in the future. And that's why the time value part of the premium decays as the option approaches expiry.

But there is more to it than simply the passage of time. Consider Pozen again, which had a very volatile stock price.

Key Point

With more time, there is a greater chance that a stock price will move further away from the current price, and there is more chance the option will come into the money.

How Volatility Affects Premium

Because the stock price is highly volatile there is a reasonable chance that the price might end up anywhere. Options premiums would be higher across a larger range of strike prices because of the greater chance that they will end up in the money at expiry.

Volatility affects the time value part of option premium. Volatility does not affect the intrinsic value of an option because that is determined solely by the strike price and the underlying stock price. Volatility inflates or deflates time premium. Options over highly volatile stocks have higher time value. Options over low volatility stocks have lower time value.

The following three charts demonstrate how an option premium expands and contracts with volatility. The charts show the premium (or value) of one $65 call over Johnson & Johnson with 92 days remaining until expiry. The first chart shows the option premium for a nominal current level of volatility. The second chart shows how an increase in volatility inflates the premium. The third chart shows how a fall in volatility deflates the premium.

In each chart the current value of the call option is shown by the uppermost small dotted line. The value at expiry is shown by the lowermost solid line with the knee at the strike price. And the broken line in the middle shows the value half way to expiry, in 46 days time.

Key Point

Options premiums are higher for stocks which are more volatile.
Option premiums are lower for stocks which are less volatile.

How Volatility Affects Premium

The chart above shows that today, with the underlying stock price just below $65 (at the vertical cursor near the centre), the option premium is approximately $2.10. Being out of the money, that premium is all time value. If volatility were to increase by 5%, and if the stock price and all other factors were to remain constant, the option premium would rise as shown below.

Key Point

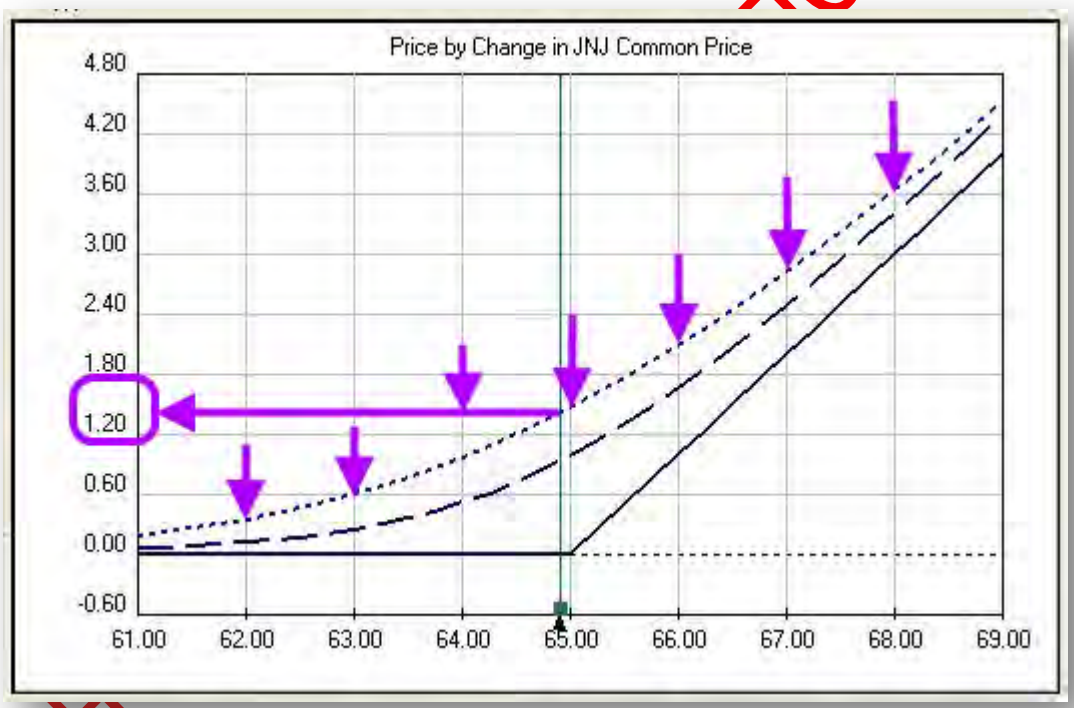
Small changes in volatility produce major changes in option premium. Changing volatility inflates and deflates option premium.

How Volatility Affects Premium

The increase in volatility has inflated the option time value. The current premium is now $2.80. The stock price remains at just below $65. The option value did not change as a result of a change in the price of the underlying stock. The time remaining until expiry did not change. The change in premium is due solely to volatility.

Notice that the change is significant. A volatility change of a mere 5% has increased the premium from $2.10 to $2.80, an increase of approximately 30%.

On the other hand, if volatility falls by 5% the premium falls also, as shown below.



[Courtesy of OptionVue Systems]

A fall in volatility decreases the time value. In this case the premium, or the value of the option, has plunged from $2.10 to approximately $1.40, a loss of one third of its value.

Small shifts in volatility can have very large impacts on option premiums. Volatility can be traded by buying and selling options when their premiums change with changes in volatility. Therefore an understanding of volatility can be very profitable. This course will demonstrate how to trade volatility changes.

Key Point

It makes sense to buy options when volatility is low, and sell or write options when volatility is high.

The Basic Idea of Exploiting Volatility

We can now put together two basic ideas. Firstly, rising and falling volatility inflates and deflates option premium. Secondly, the volatility of a stock can rise and fall over time. The width of Bollinger Bands can give an approximate representation of the level of volatility of an underlying stock, although that is ***not*** how we use Bollinger Bands.

The Bollinger Bands shown below expand and contract approximately with increasing and decreasing volatility of the underlying stock. It would make sense to buy options when volatility is low, and sell or write options when volatility is high. In so doing we would be buying when premiums are relatively low, and selling or writing when premiums are relatively high.

[Courtesy of OptionVue Systems]

CAUTION!

We do not use Bollinger Bands for any volatility analysis. We do not use Bollinger Bands for any aspect of trading related to volatility.

Key Point

We always align our options trading with forecast changes in volatility, but we do not use Bollinger Bands to try to exploit volatility.

The Basic Idea of Exploiting Volatility

Bollinger Bands are not designed to measure volatility. Bollinger Bands are unsuitable because they do not show volatility levels accurately, they do not show whether an option is expensive or inexpensive, and they are delayed. The Bollinger Band expands and contracts too long after the volatility level has changed because Bollinger Bands are calculated from past prices, well after the event.

We only use Bollinger Bands for price filtering.

The Bollinger Bands are shown above only to illustrate the concept that volatility increases and decreases over time and to introduce in broad terms why a proper understanding of volatility is essential for options trading.

Later in this course we will see how we use more accurate measures of statistical volatility and implied volatility to find candidate trades, to select optimum strategies to exploit changing levels of volatility, and to pinpoint entry timing.

Bollinger Bands are no good for exploiting volatility in trading. Instead, we use statistical volatility and implied volatility.

Vega

An understanding of how volatility affects options is critical to successful options trading. The Greek “Vega” describes how volatility affects an option's premium, just as delta and theta describe how price and time affect the premium. Curiously Vega is not in the Greek alphabet. It is easy to simply remember that the "V" from Vega stands for volatility.

We have already seen that option premiums are sensitive to changes in volatility. If volatility increases, the premium rises. If volatility decreases, the premium falls.

Vega indicates how much a premium will rise or fall as a result of a change in volatility of one percent. Vega is often expressed as a dollar value which specifies how much the premium of a single option would change in dollars for a change in volatility of one percent. For example a Vega of $0.28 means that the option premium would rise by 28 cents if the volatility of the underlying stock increased by one percent. Or, if the level of volatility fell by one percent, the option premium would fall by 28 cents. Sometimes Vega is expressed as the dollar amount by which a whole options contract might change for a volatility change of one percent. Consider a US options contract over 100 units of stock. A Vega of 28 would be interpreted as $28.00, being the amount by which the value of the whole contract changes.

We have seen so far that three important factors can affect the value of an option: the price of the underlying, time, and volatility. We'll now see how our knowledge of those factors can be used to estimate a fair value for the premium of an option.

Key Point

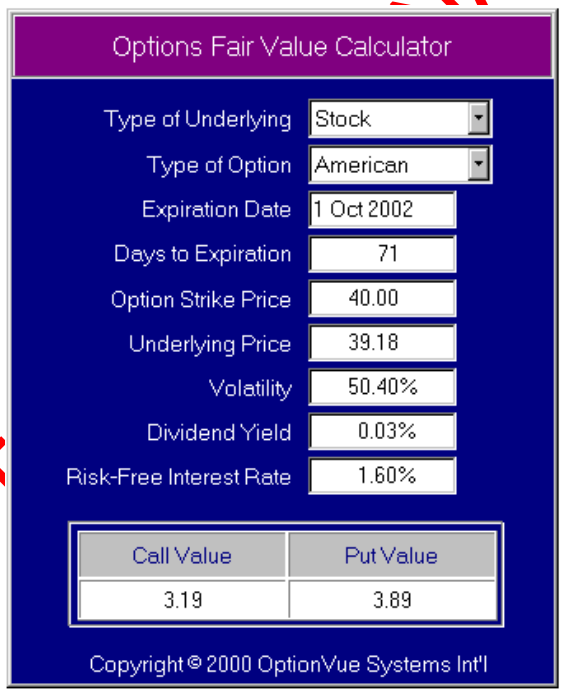
Vega measures how much an option premium would change for a 1% change in volatility.

Fair Value

The theoretical value of an option may be calculated mathematically. The theoretical value is also known as the "fair value". A fair value calculator uses mathematical models to estimate the theoretical value of an option, given certain input information. We've seen that the premium depends upon the price of the underlying, the amount of time remaining until expiry, and volatility. The premium also depends on some other factors, which need to be specified to calculate an option's fair value. Fair value calculators are freely available on the internet, often at websites of exchanges and brokers. An example is shown below.

To estimate the theoretical value of an option a fair value calculator needs the following variables as inputs to the model.

- Type of Underlying
- Type of Option
- Expiration Date
- Days to Expiration
- Options Strike Price
- Underlying Price
- Volatility (historic)
- Dividend Yield
- Interest Rate



Once the input parameters have been defined, the calculator furnishes theoretical values for the call options and the put options.

The fair value calculator can help determine whether you would pay too much or sell for too little on the market.

It may be all very well to calculate a theoretical value of an option. But when you go to buy or write an option in the real market the price will usually be different. So what use is a theoretical value in the face of cold hard market forces? You can't argue with the market to try to realise a "fair" price! Well, the calculator and an understanding of fair value are very useful because they underpin the concept of implied volatility. We use the fair value calculator in a different way from that described above.

Key Point

Fair value calculators are freely available on the internet and calculate the theoretical value of options.

Implied Volatility

If you were considering an option whose fair value did not match the actual market price, you might wonder why. What does the mismatch mean? It means the market disagrees with the theoretical value. It means the market has a different view of the inputs to the fair value calculation. There can be no disagreement on most of the input values: the strike price, days until expiry and so on are fixed.

Only one input is open to disagreement: volatility. The market can have a different view. We have seen that statistical volatility is the measure of past or historic volatility of the stock price. But that data is stale: it's history. Options traders and the market are not interested in the past. They are trading options because of future fears or expectations. There might be an impending announcement or earnings report. Or a perceived possible disaster. Options premiums reflect future expectations of volatility, not the past. That's why it is inappropriate to use the Bollinger Bands presented earlier.

If the market knows a company will issue a report then there might be an expectation of a sudden change in the underlying stock price. The option premium on the market will be driven up or down to reflect those expectations. If the market price of an option does not match the theoretical price, it is because the market expects volatility to be different in the future from what it has been to date.

Therefore, instead of using the fair value calculator to calculate a theoretical premium from past volatility, we use it in reverse. Instead of entering a value for volatility as an input to calculate fair value, we enter the current market premium to determine what the volatility theoretically should be. That theoretical volatility is called the "implied volatility".

Implied volatility is the volatility implied by the current market price of the option. Implied volatility is the volatility the underlying stock would need to have for the fair value calculator to produce a theoretical option price which matches the actual market price. It reflects the future volatility expected by the market.

You might wonder how implied volatility can be calculated for an underlying stock when there are many options over that stock. Which option's market premium implies the volatility? The sensible way to calculate implied volatility is to calculate the average implied volatility from a range of reasonable options. We would exclude options too far into or out of the money, options which are too thinly traded, too far into the future, or which haven't traded recently.

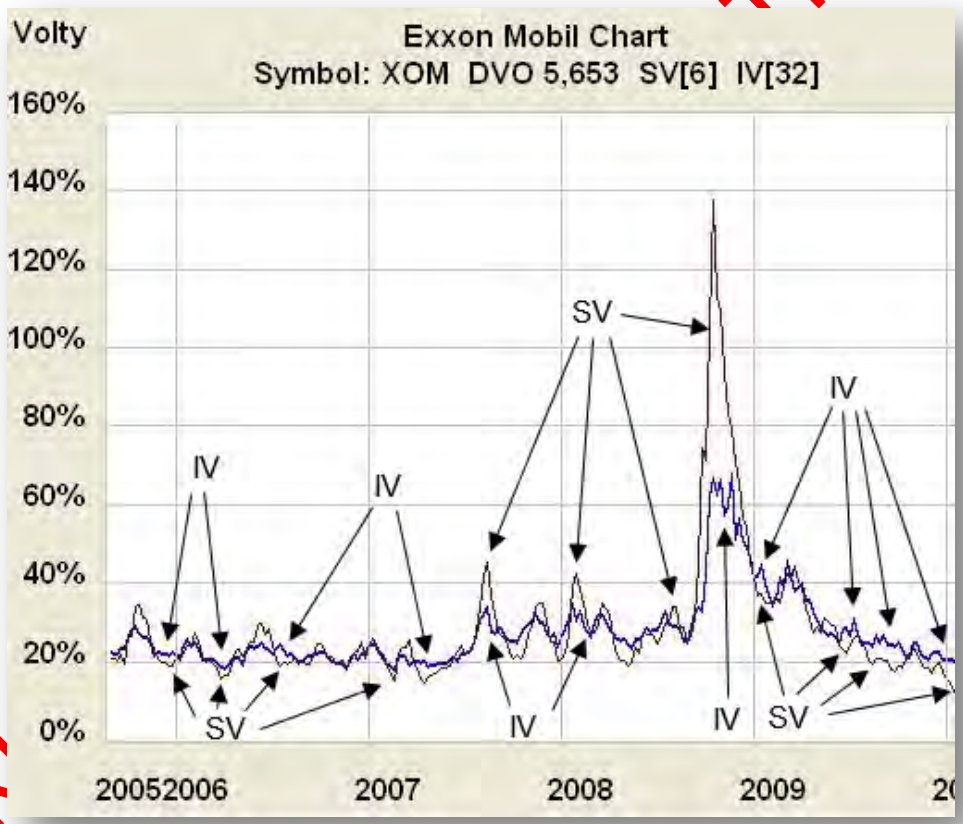
Implied volatility provides very useful and important knowledge. Implied volatility can give forewarning of changes in stock price. If option premiums suddenly rise without explanation, it is possible to deduce that something important might be about to occur in relation to the price of the underlying stock.

Implied volatility is calculated from current option market premium using the fair value calculator backwards.

Volatility Charts

The volatility of a stock changes with time. Sometimes a stock can trade within a very narrow price band with low volatility, like IYK shown earlier. At other times the price might fluctuate wildly like Pozen, with high volatility. Bollinger Bands grow fatter or become narrower as volatility rises and falls. Statistical or historic volatility is calculated from the underlying stock price movements and plotted on a chart. Similarly implied volatility can be calculated from option premiums and plotted. It is useful to plot both statistical and implied volatility on the same chart so they can be compared.

A volatility chart graphs past statistical and implied volatilities of a stock. Statistical volatility is calculated from an exponential average of the daily price volatility over the previous twenty trading days. Implied volatility is calculated from the market prices of the options.



[Courtesy of OptionVue Systems]

In the volatility chart above, the line marked SV is statistical or historic volatility. The line marked IV is the implied volatility. The historic and implied volatilities generally track approximately together. If they diverge, it indicates that the options prices are not reflecting the volatility of the underlying stock price. That's often because the market expects future volatility to be different from the immediate past.

Key Point

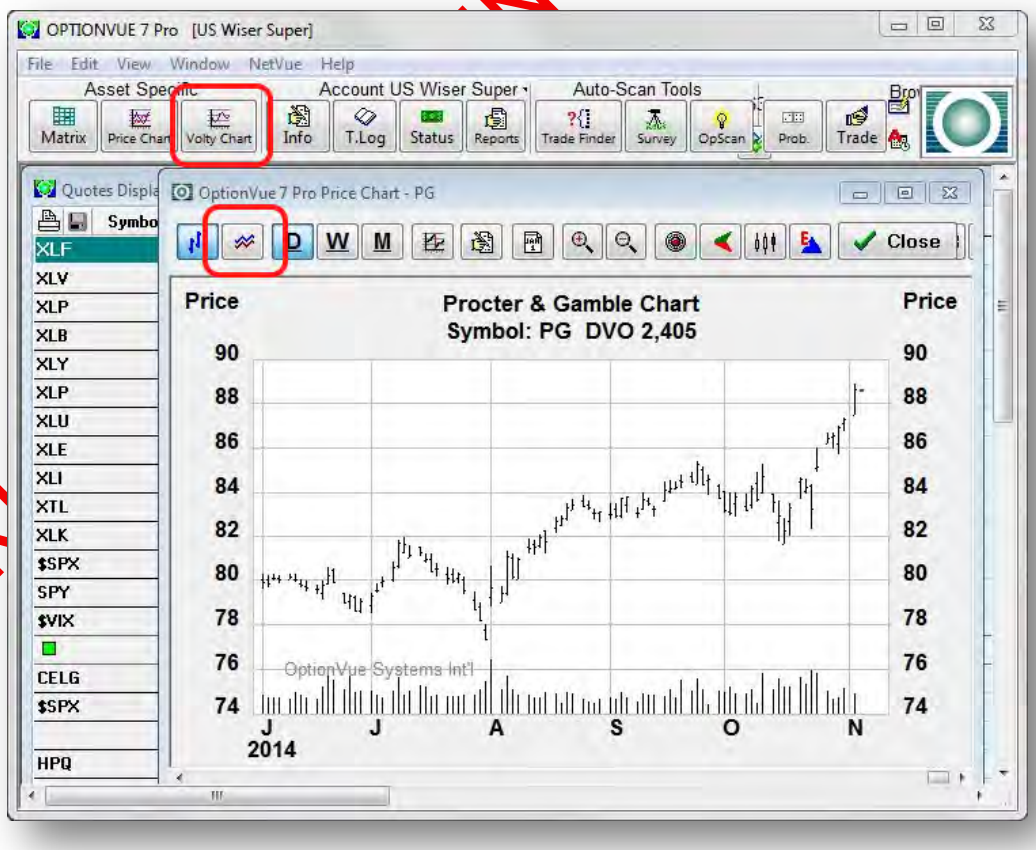
Volatility charts overlay historic or statistical volatility with implied volatility so they can be compared.

Interpreting Volatility Charts

An understanding of volatility and volatility charts is the cornerstone of a professional trading system. An understanding of volatility provides an edge over other traders who might base their trading only on price, and who might not fully understand the significance of volatility. Volatility charts are an invaluable tool. They make it easy to understand the volatility characteristics of a trade, and therefore the behaviour of the time value of the options being traded. Volatility charts are very useful because:

- they can be used to determine what is "normal" volatility;
- they enable possible volatility forecasts to be made;
- they enable traders to profit from expected changes in volatility;
- they indicate whether volatility is at an extreme away from the average;
- they enable traders to identify overvalued and undervalued options; and
- they enable traders to identify expensive and inexpensive options.

We'll examine a typical volatility chart. To open the chart click on either the "Volty Chart" button in the main OptionVue window, or, if you already have a price chart window open, click on the second button from the top left in the chart window, as shown below.



Volatility charts are rich with valuable information.

Interpreting Volatility Charts

At the top of the screen is the name of the underlying stock and its exchange code. The chart below shows the volatility characteristics of Amazon.com, with the stock code AMZN.

[Courtesy of OptionVue Systems]

The vertical axis shows the volatility levels for both implied volatility and for statistical volatility. Volatility is always measured as a percentage. The percentage value is a manufactured mathematical value. It is not really a percentage of anything tangible. Notice that volatility can exceed 100%.

Time is shown across the horizontal axis until the current day.

Two very important pieces of additional Information are shown at the top. "DVO 11,147" indicates the dollar volume of options traded, which is the average of the daily value of options traded over the last five days. The figure is expressed in thousands of dollars. DVO 11,147 means on average $11,147,000 (approximately $11 million) worth of options were traded daily in the preceding five trading days. This is useful, because as traders we prefer to trade in liquid markets.

Key Point

The DVO value helps us to find liquid options to trade.

Interpreting Volatility Charts

Also shown at the top of the chart are the current percentile rankings SV[23] for statistical volatility, and IV[58] for implied volatility. The implications of volatility percentile rankings are very significant to options traders. We will see shortly how to apply that information.

Notice on the chart that statistical and implied volatilities approximately track each other, but never quite exactly. They seem to generally rise and fall together. This is also an important observation.

The vertical line in the middle is a cursor which can be moved left and right to read all the volatility data at any selected past date. Beneath the chart are shown the cursor date along with the statistical and implied volatility data for that date. In this case the cursor is on a peak in statistical volatility which occurred during the week ending on the first of February, 2008. At that time statistical volatility was 77.1%, which, shown in the square brackets, had a statistical volatility percentile ranking of 73. Also on that date implied volatility was 61.3% which had an implied volatility percentile ranking of 62.

Notice that volatility seems to sometimes rise too high and fall back, and also fall too low before rising. Volatility doesn't seem to remain steady. This waxing and waning of volatility is comparable with the widening and narrowing of Bollinger Bands shown earlier. But instead of using Bollinger Bands to determine when options are expensive or inexpensive, we will be using implied volatility, which is much more useful.

Volatility charts show us how statistical and implied volatilities have risen and fallen over past times.

Why Volatility Is Important

Mean Reversion Tendency

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Percentile Rankings

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Summary

We now understand the impact that shifting volatility has on both bought and sold options' premiums. Reading and understanding the valuable information offered by volatility charts gives us a source of many potential trades and a trading edge over those who simply pick trades based on price direction.