Volatility

OIC The Options Industry Council

Giving you the power of Options

1 Presentation Outline

- Option Pricing Review
- Volatility – Definitions & Concepts
- Volatility as an Option Pricing Factor
- Volatility Measurement
- Looking Back vs. Looking Forward
- Implied Volatility
- Changing Implied Volatility
- Using Implied Volatility
- Be Aware of Implied Volatility Levels
- Dollar Impact of Changing Implied Volatility
- Strategies
- Closing Thoughts

Exploring Historical and Implied Volatility

The Options Industry Council

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For the sake of simplicity, the examples that follow do not take into consideration commissions and other transaction fees, tax considerations, or margin requirements, which are factors that may significantly affect the economic consequences of a given strategy. An investor should review transaction costs, margin requirements and tax considerations with a broker and tax advisor before entering into any options strategy.

Options involve risk and are not suitable for everyone. Prior to buying or selling an option, a person must receive a copy of *Characteristics and Risks of Standardized Options.* Copies have been provided for you today and may be obtained from your broker, one of the exchanges or The Options Clearing Corporation, One North Wacker Drive, Suite 500, Chicago, IL 60606 or call 1-888-OPTIONS or visit www.optionseducation.org.

Any strategies discussed, including examples using actual securities and price data, are strictly for illustrative and education purposes and are not to be construed as an endorsement, recommendation or solicitation to buy or sell securities.

Option Pricing Review

Just the Basics

Equity Option Pricing Factors

- Factors that affect an equity option's price:
  - underlying stock price (or ETF)
  - strike price
  - time until expiration
  - volatility
  - interest rate
  - dividends
- Among these factors, those that affect an option's time value:
  - volatility
  - interest rate
  - dividends

  these are impacted by time until expiration
- In addition to pricing factors time value is affected by supply and demand

Equity Option Pricing Model

- Option pricing model is a mathematical formula
  - input: six pricing factors
  - output: theoretical values + Greeks
- Interest rate and dividends are assumptions – normally predictable
- Stock price is not so predictable because of *volatility*
- Example pricing models
  - Black-Scholes (1973) – original model (Nobel Prize)
  - Cox-Ross-Rubenstein (1979) – binomial model

Option Premium Review

- Equity option premium consists of…
  - intrinsic value (if any)
  - time value
- Intrinsic value
  - only in-the-money options
  - in-the-money amount
- Time value
  - any premium in excess of intrinsic value
  - at- and out-of-the-money options have only time value

Why Care about Volatility?

- Factors affecting time value
  - time
  - interest
  - dividends
  - volatility

  ] cost of money
- Time until expiration = known
- Cost of money = normally predictable
- Volatility = largely unpredictable (“unknown”)
  - key factor affecting an option’s time value (market value)

Volatility

Definitions & Concepts

Volatility: Changing Stock Price

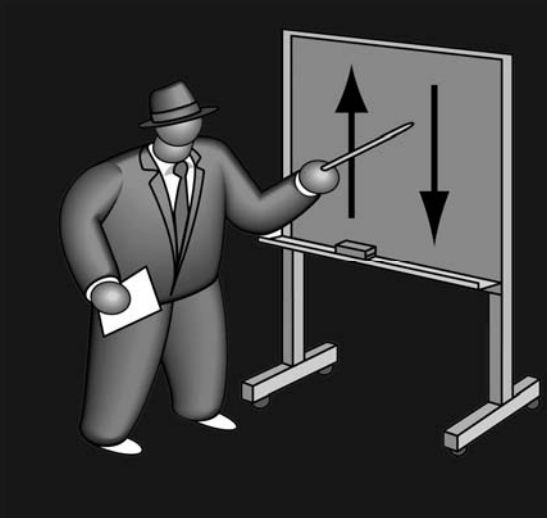
- Volatility reflects changing underlying stock price, but does not imply a price trend:

Not an uptrend

Not a downtrend

Volatility: Fluctuation

- Volatility reflects fluctuation in underlying stock price
  - moves to the upside
  - moves to the downside
  - over days, weeks, months, or longer



Higher vs. Lower Volatility

- Compare price action of two stocks over a given time period
  - both begin and end timeframe at same price
  - what happens during timeframe is *volatility*

Volatility by Market Sector

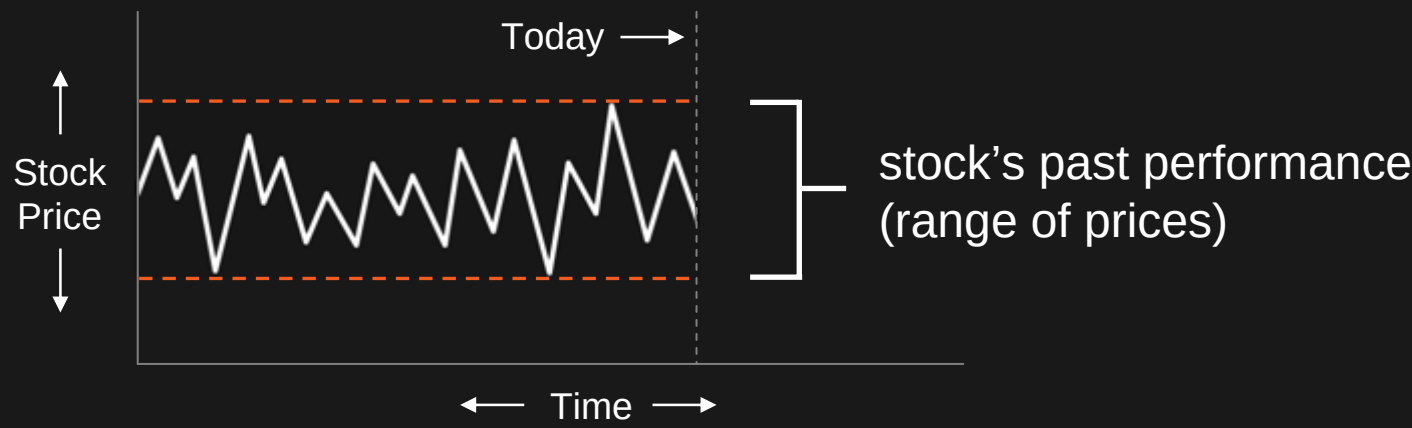
- Certain industry sectors in the marketplace may be characterized by having lower vs. higher volatility levels
- Lower volatility sectors
  - traditionally lower growth rates for specific stocks
- Higher volatility sectors
  - traditionally higher growth rates for specific stocks
- However, perhaps more importantly:
  - volatility of specific stocks within a sector may vary significantly
  - sector volatilities often change

Historical Volatility

- A stock's volatility in the past
  - can be observed and quantified
  - this is *"historical"* volatility
  - a statistic, or a fact, not a prediction

Historical Volatility: What Does It Tell You?

- Historical volatility
  - usually calculated from stock's daily closing prices
  - other data can be used – e.g., midpoint between high/low prices
  - measurement commonly reflects past year – annualized
  - can represent other timeframes – know what you're looking at



History Repeat Itself?

- Will a stock's historical volatility level continue into the future?
  - not necessarily
  - past performance no guarantee of future performance
  - assumption about future is subjective – yours or someone else's

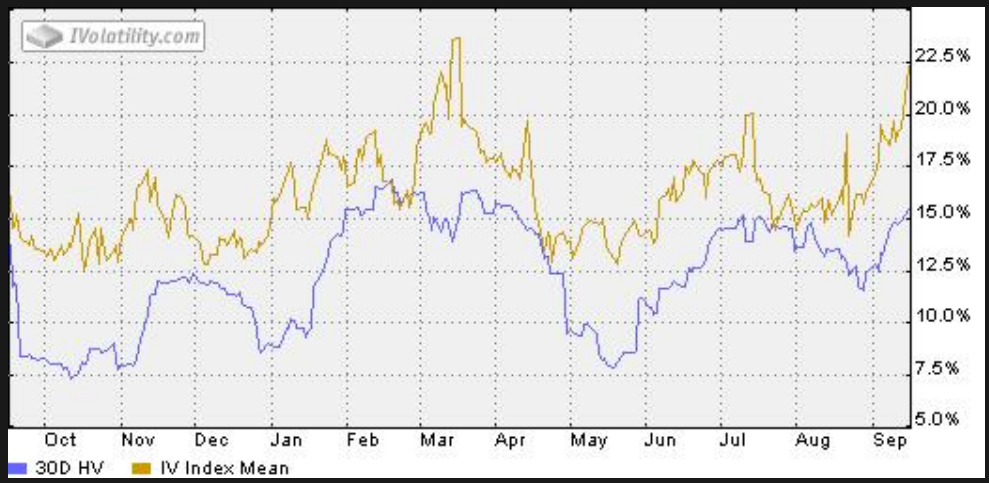
Historical Volatility – Where to Find

- How to find historical volatility
  - brokerage firm Web sites
  - quote service
  - option advisory service
  - search the Web
  - *www.optionseducation.org/quotes*
- Historical volatility can be recalculated daily, weekly, etc.
  - if you're retrieving from source above know how current
- Can calculate yourself
  - spreadsheet facilitates calculation
  - formulas available on Web

Historical Volatility – Where to Find

- From *www.optionseducation.org/quotes*
  - then “Detailed Options Chains”

	Current	1 WK AGO	1 MO AGO	52 wk Hi/Date	52 wk Low/Date
HISTORICAL VOLATILITY					
10 days	20.13%	19.52%	14.22%	21.05% - 19-Mar	4.73% - 22-Aug
20 days	15.38%	13.87%	13.28%	18.08% - 13-Feb	6.54% - 18-Oct
30 days	15.41%	14.52%	13.47%	16.94% - 19-Feb	7.30% - 12-Oct



Graph from Ivolatility.com

Volatility
as an
Option Pricing Factor

Options, Volatility and the Future

- An equity option is a contract to either buy or sell shares of stock
  - at a specified price (the strike)
  - on or before a point *in the future* (its expiration)
- Volatility measurement used as pricing factor
  - assumption on stock's volatility level up to its expiration
  - *"expected"* volatility (subjective prediction)
  - infers price range for stock during option's lifetime
  - because of predictive nature – the risky factor
- Impact on option prices
  - shorter-term – key unknown
  - longer-term – unknown (+ cost of money)

Volatility As Stock Risk

- Own stock primarily for income?
  - dividends – price increase not as important
- Own stock primarily for profit on price increase?
  - volatility reflects risk of owning stock in future
  - low volatility → smaller range of possible stock prices
  - high volatility → greater range of possible stock prices
- High volatility → stock as likely to perform very well as very poorly

Volatility As Option Risk

- Remember what a stock's future volatility predicts
  - range of possible stock prices
- Option to be exercised/assigned during its lifetime?
  - whether option in- or out-of-the-money
  - determined by underlying stock price
  - likelihood set by range of possible stock prices
- Where is stock likely to be trading before expiration?
  - your expected volatility reflects this
  - expected volatility → expected stock price range

Volatility vs. Buyers and Sellers

- **Higher** volatility = higher premiums
  - option buyers pay more for more stock fluctuation
  - option sellers want more for increased risk
- **Lower** volatility = lower premiums
  - option buyers pay less for smaller fluctuation
  - option sellers take less for decreased risk

Volatility vs. Call and Put Prices

- Remember that volatility represents stock price fluctuation
  - price moves up or down
  - higher volatility infers greater range of stock prices
  - lower volatility infers smaller stock price range

Therefore, with other pricing factors remaining constant:

- As stock volatility increases ↑
  - both call and put prices generally increase ↑
- As stock volatility decreases ↓
  - both call and put prices generally decrease ↓

Time Value

- Time value represents premium you are paying (or selling) for time
  - underlying stock can make favorable move, or
  - stock price can stabilize
  - depending on motive for option profit
- If cost of money were zero (no interest/dividends), then time value would be set only by volatility!
  - volatility would determine any opportunity costs
  - volatility would determine any realized financial loss

Volatility Measurement

Volatility: Standard Deviation

- Volatility is a measure of stock price *fluctuation*
- Statistically, volatility is the *annualized standard deviation* of a stock's daily price changes
- Standard deviation is a measure of how widely *dispersed* a set of data points (stock prices) are up and down from the mean (average) price
  - the set is usually closing prices over the period of one year
  - can represent other timeframes

Volatility: Standard Deviation

- The distribution of closing stock prices is considered "normal"
  - a closing price just as likely to be above the mean as below
- The wider the range of stock prices, from highest to lowest value away from the mean, the greater the standard deviation
- The greater the stock's volatility the greater the standard deviation

Normal Distribution

- Consider stock XYZ and distribution of closing prices over short timeframe
- Normal distribution when number of occurrences and price range on upside mirror image of downside

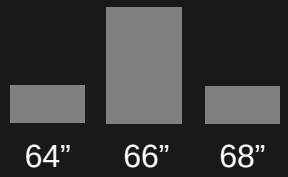
Standard Deviation: Examples

You have 5 women in your family

- Each is 66” tall

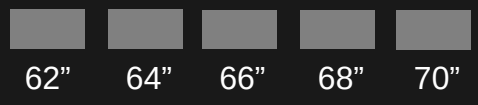
no variance
standard deviation = 0

- 1 is 64” tall – 3 are 66” tall – 1 is 68” tall



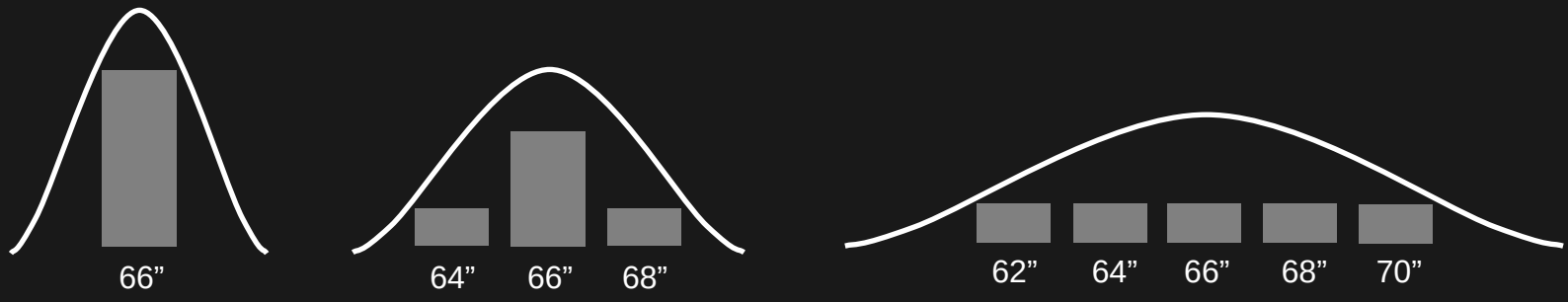
low variance
standard deviation = 1.41

- 1 is 62” tall – 1 is 64” tall – 1 is 66” tall – 1 is 68” tall – 1 is 70” tall



greater variance
standard deviation = 3.16

Standard Deviation: Examples



SD = 0 **SD = 1.41** **SD = 3.16**

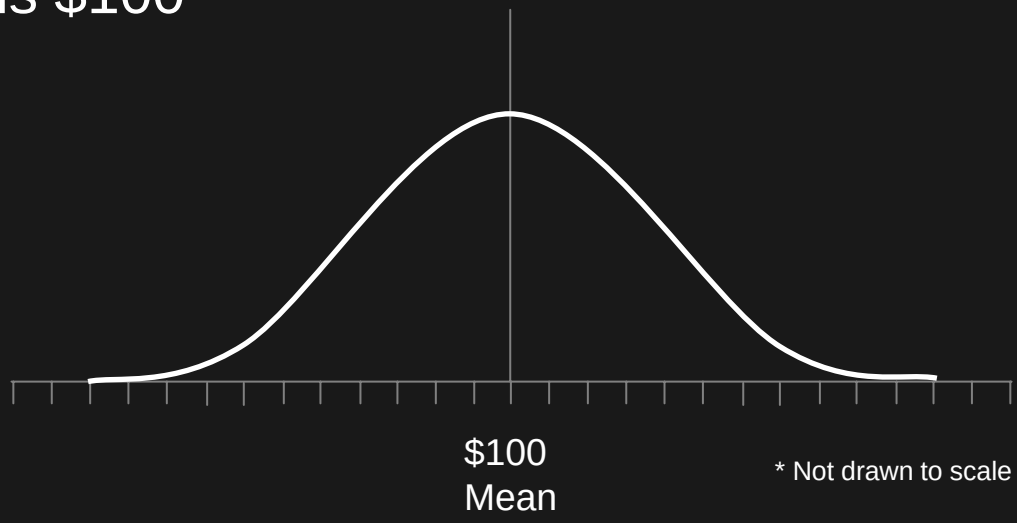
- Again, with normal distribution:
  - greater range of data points → wider distribution about mean
  - wider distribution → greater standard deviation
- As you will see:
  - greater standard deviation → higher stock volatility

Historical Volatility

- Historical volatility for any given stock
  - annualized standard deviation (SD) of daily price changes
  - expressed in percent
- Percent amount represents:
  - relative change up or down from mean (average) price
  - a range of stock prices
- The range – a general rule of statistics
  - assuming a log-normal distribution of stock prices
  - prices within 1 SD ≈ 68% of the time
  - prices within 2 SDs ≈ 95% of the time
  - prices within 3 SDs ≈ 99% of the time

Historical Volatility and Standard Deviation

- Closing prices of XYZ over last year – mean (average) price is $100



- Annualized SD, or historical volatility, is hypothetically 25%
  - 1 standard deviation = 25% x $100 mean = $25
  - 2 standard deviations = 50% x $100 mean = $50
  - 3 standard deviations = 75% x $100 mean = $75

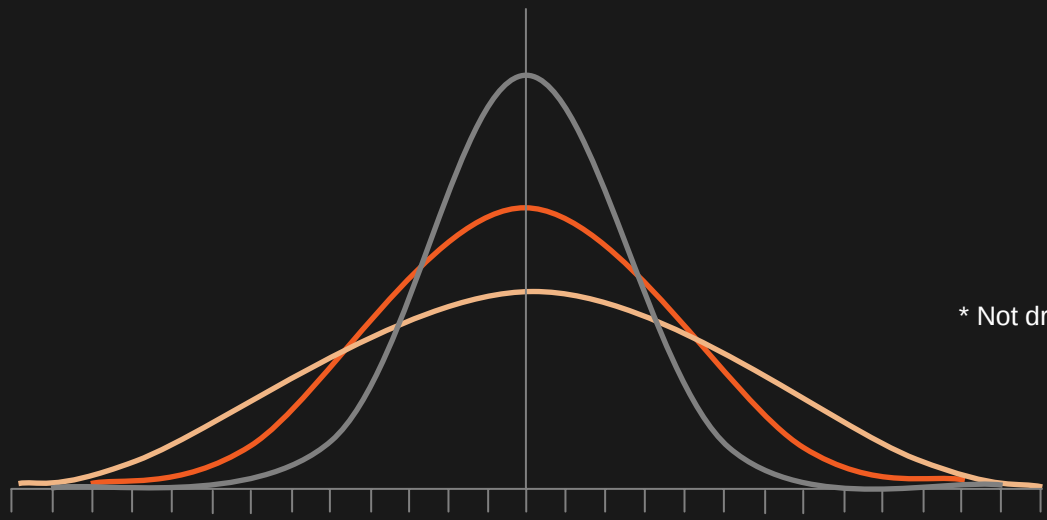
Historical Volatility and Standard Deviation

- With a 25% historical volatility XYZ has been
  - within ± 1 SD of $25 from mean – 68% of the time
  - within ± 2 SDs of $50 from mean – 95% of the time
  - within ± 3 SDs of $75 from mean – 99% of the time

* Not drawn to scale

Comparing Distributions

- Compare distributions of three stocks – each with different volatility
  - Stock A = 15% volatility
  - Stock B = 25% volatility
  - Stock C = 35% volatility



* Not drawn to scale

Looking Back
vs.
Looking Forward

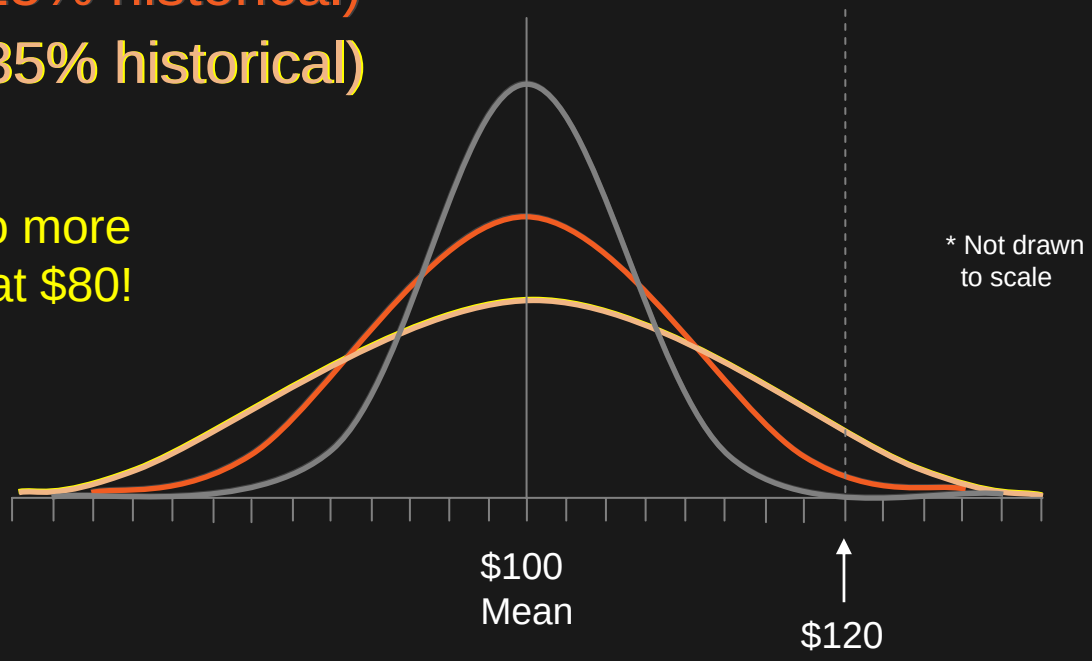
Looking Back – Looking Forward

- Historical volatility is taking a look back at a stock's past price performance
  - by definition it is history
- Past performance does not guarantee future performance
  - not a revelation
  - virtually every investor has had experience with this fact
- Establishing an option position?
  - consider the future – i.e., lifetime of option
  - should have target price for underlying stock
  - select strike price accordingly
  - an "expected" volatility might help set expectation for profit

Which Stock to Buy?

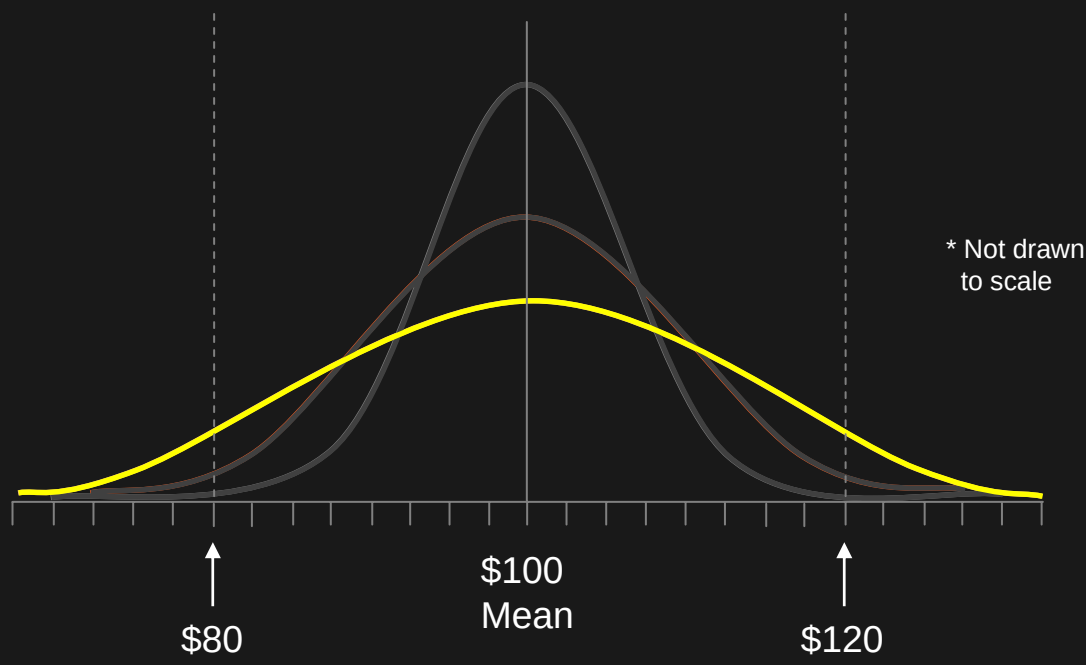
- Assuming stocks are trading for $100 today, and your expected volatility is same as historical, which stock is more likely to trade for $120?
  - Stock A = (15% historical)
  - Stock B = (25% historical)
  - **Stock C = (35% historical)**

Stock C is also more likely to trade at $80!



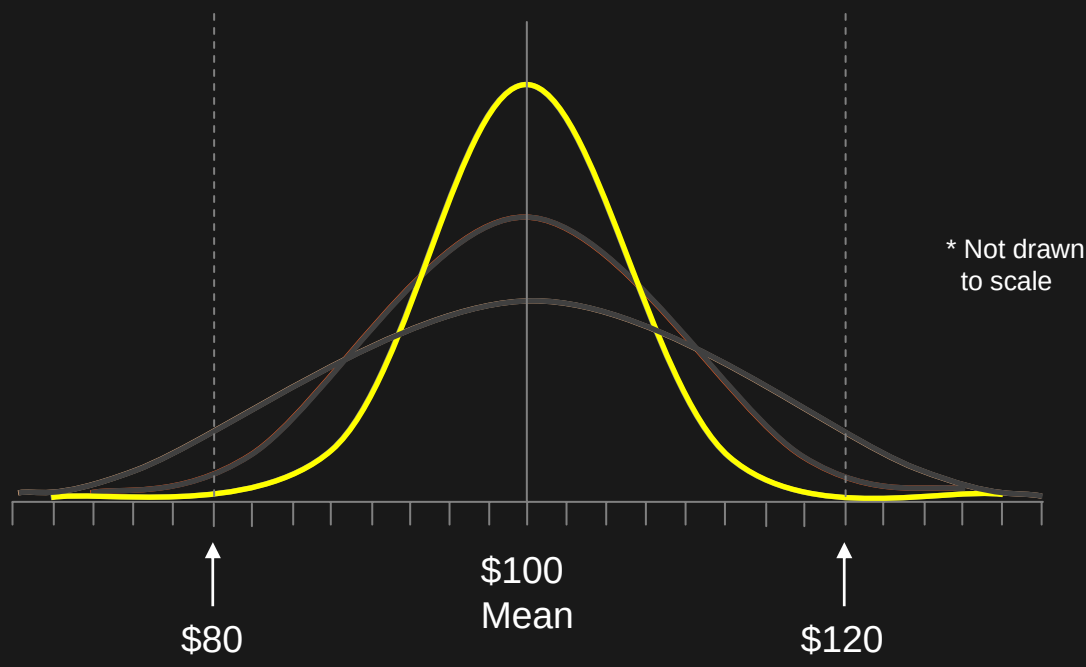
Which Option to Buy?

- Given these distributions, on which stock would you rather buy a $120 call…or an $80 put?
  - Stock A
  - Stock B
  - Stock C



Which Option to Sell?

- Given these distributions, on which stock would you rather sell a $120 call…or an $80 put?
  - Stock A
  - Stock B
  - Stock C



Looking Forward: Expected Volatility

- Expected volatility required before establishing an option position?
  - not necessarily
  - stock target price may be based entirely on fundamentals, or
  - an advisor might be encouraging a given position, or
  - you might be taking an entirely speculative position
- Valuing option with pricing model before option purchase or sale
  - model requires a volatility input
  - use your own expected volatility, someone else's or historical
  - in any case you're making a forecast – be aware of that
- In the meantime, the marketplace is collectively assuming a volatility
  - "implied" volatility

Implied Volatility

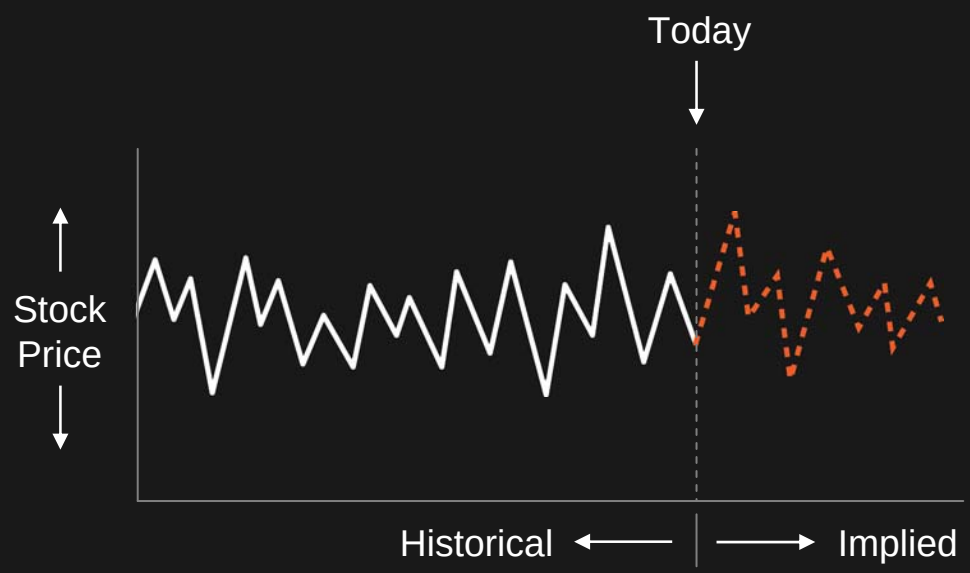
Market Prices of Options

- You’re valuing an option with a pricing model (calculator)
  - might be using stock’s historical volatility
  - might be using your own expected volatility
- Current market price for option doesn’t make sense
  - higher or lower than your calculation
  - if other input values are “correct” then what is the issue?
- “Implied” volatility

Implied Volatility: Definition

- Implied volatility
  - volatility assumption at which option is currently priced in market
  - obtained via option pricing model
  - volatility input resulting in value same as current market price
- Reflects underlying stock volatility expected by marketplace
  - consensus of all market participants
- Who ultimately determines option market prices?
  - option professionals (market makers)
  - institutional and other large asset managers
  - individual investors
  - everybody who makes a bid/ask price and trades an option

Implied Volatility Represents the Future



- *Implied* volatility reflects current expectations about *future* volatility

Implied vs. Historical Volatility

- Implied volatility
  - can be at great variance with historical volatility
  - not necessarily right or wrong
- Changing implied volatility
  - expect over time
  - generally a dynamic feature of any option's premium
  - may occur intra-day
  - may occur abruptly and significantly
  - does not require change in stock price
  - does not require change in stock's volatility (i.e., historical)

Implied vs. Historical Volatility

- A simple but important point
  - implied volatility is a feature only of options
  - by definition it only implies a stock's future volatility
- Implied volatility return to stock's historical volatility level?
  - not necessarily
  - do not assume it will
- Why be concerned about implied volatility?
  - directly affects market value of your options (time value)
  - not predictable
  - can explain option price movement you might not expect or understand

Implied Volatility: How to Find?

- Commonly on Internet – option chains
  - *www.optionseducation.org/quotes*
  - brokerage firm or exchange Web sites
  - may be real-time or delayed calculations
- Printed information from advisory services or newsletters
  - less current information usually
- You might find
  - implied for single option series (XYZ June 60 calls)
  - average implied of all series in class (all XYZ options)
- Calculate yourself
  - option pricing model via option calculator

Implied Volatility: Via Option Chain

- Go to *www.optionseducation.org/quotes*
  - then “Detailed Option Chains”
  - find implied volatility for each option series
  - prices delayed by 20 minutes
  - sample below for illustrative purposes only

Strike	Option Symbol		Bid/Ask Mean	Bid	Ask	Change (%)	Volume	Open Interest	Option Value	Implied Vola%
24.0	C	GEGD	3.650	3.60	3.70	-0.50 (-13.70)	0	50	3.4422	43.69%
	P	GESD	0.195	0.19	0.20	0.02 (10.53)	0	1,589	0.0144	41.94%
25.0	C	GEGE	2.780	2.75	2.81	-0.58 (-21.32)	0	375	2.495	40.53%
	P	GESE	0.340	0.33	0.35	0.07 (20.00)	0	21,501	0.0651	40.05%
26.0	C	GEGM	1.990	1.97	2.01	-0.41 (-20.60)	0	1,230	1.6441	37.82%
	P	GESM	0.550	0.54	0.56	0.14 (25.00)	0	9,286	0.2122	37.51%
27.0	C	GEGQ	1.315	1.30	1.33	-0.30 (-22.56)	0	2,250	0.961	35.51%
	P	GESQ	0.875	0.87	0.88	0.19 (21.59)	0	26,205	0.5272	35.31%

Implied Volatility

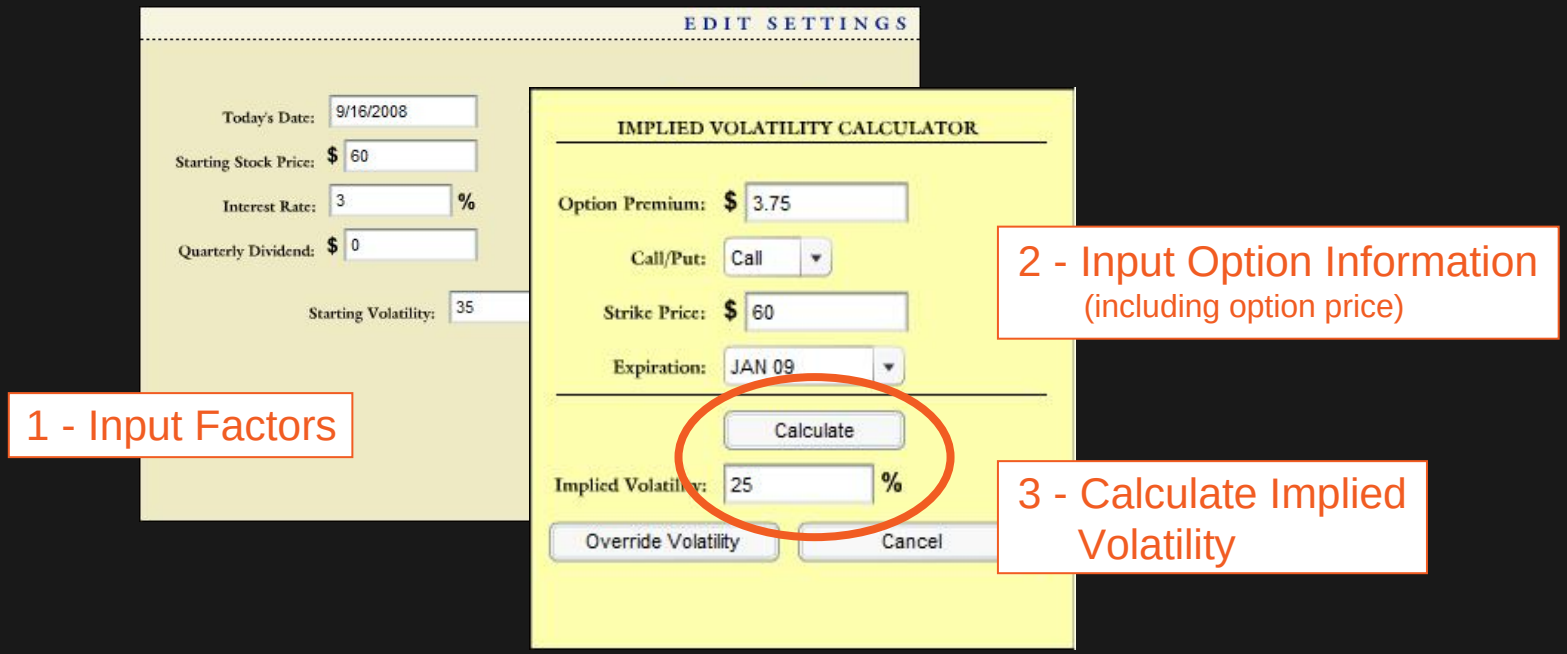
Portion of Option Chain
from IVolatility.com

Implied Volatility: Via Calculator

- Any option pricing calculator
  - “input” historical volatility to begin
  - theoretical price not market price – change volatility
  - increase volatility input to raise price, vice versa
  - when input produces current price → **implied volatility**
- If calculator has function to calculate implied volatility
  - input current option price → implied volatility

Implied Volatility: Via The Options *Investi*gator Calculator

- Go to *www.optionseducation.org*
  - The Options *Investi*gator
  - click on “Trading Tools” then “Position Simulator”



Implied Volatility: Effect on Option Prices

- Change in stock (historical) volatility
  - not necessarily correlates with a change in implied volatility
  - other factors involved
  - may not always affect option price

Other pricing factors remaining constant, a change in implied volatility will affect option prices:

- As implied volatility increases ↑
  - both call and put prices will increase ↑
- As implied volatility decreases ↓
  - both call and put prices will decrease ↓

Changing Implied Volatility: Good or Bad Thing?

- Given the effect of changing implied volatility on option prices, let the following points become intuitive… don't have to think about them
- Long an option (call or put)
  - you want option price to increase (obviously)
  - you want implied volatility to increase (maybe not so obvious)
- Short an option (call or put)
  - you want option price to decrease (obviously)
  - you want implied volatility to decrease (maybe not so obvious)

Implied Volatility: What Can Affect It?

- Change in underlying stock volatility
  - but not required
- Supply and demand
  - difficult to predict
  - more option buyers than sellers → prices go up (and vice versa)
  - change in underlying stock price not necessary
  - if no change in other price factors → implied volatility changes
- Uncertainty about underlying stock performance
  - fundamentals
  - rumors
  - earnings expectations vs. announced

Implied Volatility: What Can Affect It?

- Changing implied in other option classes in same industry sector
- General stock market psychology
  - economic data (unemployment, Consumer Price Index, etc.)
  - Federal Reserve actions
  - commodity prices (oil, gold, grains, etc.)
  - world political or military events
- Market activity
  - more volume → generally increased implied volatility
  - market in doldrums → implied generally drops

Implied Volatility: What Can Affect It?

- Rise in market
  - implied levels generally decrease (at least short-term)
  - sudden and significant move can increase implied volatility
- Drop in market
  - implied levels generally increase (at least short-term)
- Point of interest
  - unfortunately panic is often more impressive than optimism!
- Points worth repeating
  - multiple factors affect implied – collective effects are dynamic
  - result → changing implied levels can be totally unexpected

Changing Implied Volatility

Some Examples

Changing Implied Volatility: Example #1

- You buy an XYZ Dec 50 call for $3.00
  - XYZ stock at $50.00
  - 60 days until expiration
- Next day the Dec 50 call is trading for $3.40
  - XYZ stock fluctuated slightly but again trading at $50.00
- What has happened?
  - implied volatility level of Dec 50 call has increased
  - implied level 35% when purchased – 40% the next day
  - you have an unrealized profit
- If you had written this call then you might not be so happy

Changing Implied Volatility: Example #2

- You buy an XYZ Jun 60 call for $3.50
  - XYZ stock at $60.00
  - 60 days until expiration
- Next day XYZ stock rises to $61.00
  - the Jun 60 call drops in price to $3.20
- With this favorable move in stock price what has happened?
  - implied volatility level of Jun 60 call has decreased
  - implied level 35% when purchased – 25% the next day
  - you have an unrealized loss you did not expect
- If you had written this call then you might be much happier

Changing Implied Volatility: Example #3

- You write an XYZ Sep 80 covered call
  - buy XYZ stock at $78.00 and sell Sep 80 call at $4.00
- Next day XYZ stock rises to $79.00
  - the Sep 80 call drops in price to $3.80
- What has happened?
  - stock up → favorable event
  - short call down due to declining implied → favorable event
  - you have an unrealized profit on both legs → you like this
- What might make you unhappy?
  - stock up and implied volatility up
  - stock down and implied volatility up

In-the-Money, At-the-Money, Out-of-the-Money

- Changing implied does not affect all options to the same degree
- In-the-money calls and puts
  - premium mostly intrinsic value, especially if deep
  - little time value so volatility effect usually minimal
- At-the-money calls and puts
  - premium all time value – greatest dollar amount of time value
  - volatility effect the greatest in nominal terms
  - more dollars in time value → more dollars to make or lose

In-the-Money, At-the-Money, Out-of-the-Money

- Out-of-the-money calls and puts
  - all time value – small dollar amounts
  - volatility effect the greatest in percentage terms
- Note on implied volatility of far out-of-the-money options
  - calculated implied may not be meaningful
- Example
  - XYZ is $50 – average implied for XYZ options is 25%
  - XYZ 75 call is far out-of-the-money – theoretical is $0.01
  - call can't trade for less than $0.05 (depends on class)
  - at market price of $0.05 its implied is 35%
  - if it trades for $0.10 (an uptick) its implied could be over 40%

Using Implied Volatility

What's the Implication?

- Historical volatility
  - just that...it's history
  - measures variance of past stock prices from a mean price
  - probabilities prices were within 1 or more standard deviations (SDs)
- Implied volatility
  - looks to the future
  - "predicts" ranges of variance with the same probabilities
- Remember
  - volatility measurements express standard deviations in percent
  - e.g., volatility of 20% = 1 SD of 20% above or below mean price
  - 1 SD is an event that statistically occurs ≈ 68% of the time

Look into the Future: 1 Year

- Let's assume:
  - XYZ is currently trading at $80
  - XYZ options are trading at annualized 20% implied volatility
  - 1 SD of 20% represents $80 x 20% = $16
- Statistically, you can expect the following results for XYZ over the next year:

Variance	Standard Deviation Amount	Trading Range	Probability Within Range	Probability Outside Range
± 1 SD	$16	$64 ↔ $96	≈ 68%	≈ 32%
± 2 SD	$32	$48 ↔ $112	≈ 95%	≈ 5%
± 3 SD	$48	$32 ↔ $128	≈ 99%	≈ 1%

Look into the Future: Less Than 1 Year

- To take an annualized volatility and calculate standard deviation amounts for periods of less than 1 year, use the following formula:

$$\frac{\text{annualized volatility \%}}{\sqrt{\text{time period}}} \times \text{stock price}$$

- "Time periods" you might use in formula
  - 1 quarter = **4** (quarters in a year)
  - 1 month = **12** (months in a year)
  - 1 week = **52** (weeks in a year)
  - 1 day = **256** (approx. trading days in a year)

Look into the Future: 1 Quarter

- XYZ is trading at $80 – options at annualized 20% implied volatility
- Standard deviation amount for 1 quarter:

$$\frac{20\%}{\sqrt{4}} \times 80 = \frac{.20}{2} \times \$80 = \textbf{\$8.00}$$

- Statistically, you can expect the following results for XYZ over the next quarter year:

Variance	Standard Deviation Amount	Trading Range	Probability Within Range	Probability Outside Range
± 1 SD	$8	$72 ↔ $88	≈ 68%	≈ 32%
± 2 SD	$16	$64 ↔ $96	≈ 95%	≈ 5%
± 3 SD	$24	$56 ↔ $104	≈ 99%	≈ 1%

Look into the Future: 1 Month

- XYZ is trading at $80 – options at annualized 20% implied volatility
- Standard deviation amount for 1 month:

$$\frac{20\%}{\sqrt{12}} \times \$80 = \frac{.20}{3.46} \times \$80 = .058 \times \$80 \approx \mathbf{\$4.64}$$

- Statistically, you can expect the following results for XYZ over the next 1 month:

Variance	Standard Deviation Amount	Trading Range	Probability Within Range	Probability Outside Range
± 1 SD	$4.64	$75.36 ↔ $84.64	≈ 68%	≈ 32%
± 2 SD	$9.28	$70.72 ↔ $89.28	≈ 95%	≈ 5%
± 3 SD	$13.92	$66.08 ↔ $93.92	≈ 99%	≈ 1%

Look into the Future: 1 Week

- XYZ is trading at $80 – options at annualized 20% implied volatility
- Standard deviation amount for 1 week:

$$\frac{20\%}{\sqrt{52}} \times \$80 = \frac{.20}{7.21} \times \$80 = .028 \times \$80 \approx \mathbf{\$2.24}$$

- Statistically, you can expect the following results for XYZ over the next 1 week:

Variance	Standard Deviation Amount	Trading Range	Probability Within Range	Probability Outside Range
± 1 SD	$2.24	$77.76 ↔ $82.24	≈ 68%	≈ 32%
± 2 SD	$4.48	$75.52 ↔ $84.48	≈ 95%	≈ 5%
± 3 SD	$6.72	$73.28 ↔ $86.72	≈ 99%	≈ 1%

Consider What Implied Is Implying

- Establishing an option position
  - consider strike, premium paid/received and break-even point
  - consider ranges of stock price over option lifetime as predicted by implied volatility
  - what is the probability you might profit?
- Test your strategy beforehand with a pricing calculator
  - adjust volatility and underlying stock price
  - test various points in time before expiration
  - consider best case vs. worst case scenarios
  - understand effect of changing implied volatility on your risk vs. reward potential

Implied Volatility As "Premium" Gauge

- With each option trade there is not a deliberate attempt to account for that option's implied volatility
  - many market participants making bid/ask prices
  - some participants paying attention to implied, others not
  - supply and demand plays a powerful role in setting prices
  - as a result implied levels constantly fluctuate
- Implied volatility's effect is only on time value
  - implied can be observed – it can be calculated (measured)
  - monitoring implied levels → useful for monitoring relative levels of time value
  - might help decide whether to buy or write contracts
  - can help decide when to get in and get out of the market

Be Aware
of
Implied Volatility Levels

Buying High or Buying Low?

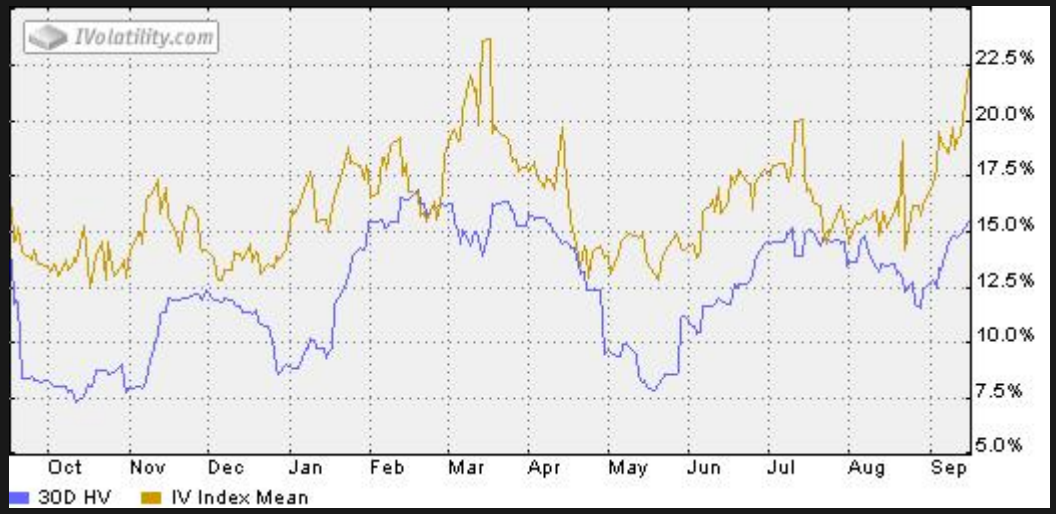
- Even with no opinion about volatility, before moving into the market be aware of current implied level relative to levels in past
  - for your option class
  - for broad market (VIX® perhaps)
- Be careful when:
  - buying an option at implied at high end of past range
  - selling an option at implied at low end of range
- As for an option being relatively over- or undervalued
  - this is determined largely by implied volatility

Investigating Implied Volatility

- Investigating past implied volatility levels for a class of options
  - information might be found via Web sites, quote services or advisors
  - *www.optionseducation.org* also a source
- Put today's implied level in perspective
- What kinds of information might you find?
  - implied for specific option series (XYZ June 60 call)
  - averaged implied for all options in a class (all XYZ options)
  - implied for all calls or all puts in a class (all XYZ calls)
  - average implied for at-the-money options in a class

Investigating Implied Volatility: Example Graph

- Graph of option class implied volatility
  - *www.optionseducation.org/quotes*



Buy or sell at this implied?

Buy or sell at this implied?

Graph from Ivolatility.com

Investigating Implied Volatility

- You will not always find implied volatility level to be the same across strike prices
  - sample below for illustrative purposes only

Strike	Option Symbol		Bid/Ask Mean	Bid	Ask	Change (%)	Volume	Open Interest	Option Value	Implied Vola%
24.0	C	GEGD	3.650	3.60	3.70	-0.50 (-13.70)	0	50	3.4422	43.69%
	P	GESD	0.195	0.19	0.20	0.02 (10.53)	0	1,589	0.0144	41.94%
25.0	C	GEGE	2.780	2.75	2.81	-0.58 (-21.32)	0	375	2.495	40.53%
	P	GESE	0.340	0.33	0.35	0.07 (20.00)	0	21,501	0.0651	40.05%
26.0	C	GEGM	1.990	1.97	2.01	-0.41 (-20.60)	0	1,230	1.6441	37.82%
	P	GESM	0.550	0.54	0.56	0.14 (25.00)	0	9,286	0.2122	37.51%
27.0	C	GEGQ	1.315	1.30	1.33	-0.30 (-22.56)	0	2,250	0.961	35.51%
	P	GESQ	0.875	0.87	0.88	0.19 (21.59)	0	26,205	0.5272	35.31%

Portion of Option Chain
from IVolatility.com

Implied volatility is decreasing

Investigating Implied Volatility

- You will not always find implied volatility levels to be the same across expiration months
  - samples below for illustrative purposes only

July

Strike	Option Symbol	Bid/Ask Mean	Bid	Ask	Change (%)	Volume	Open Interest	Option Value	Implied Vola%
24.0	C GEGD	3.650	3.60	3.70	-0.50 (-1[illegible].70)	0	50	3.4422	43.69%
	P GESD	0.195	0.19	0.[illegible]	[illegible]	0	1,589	0.0144	41.94%
25.0	C GEGE	2.780	2.75	2.8[illegible]	-0.[illegible]58 (-2[illegible].32)	0	375	2.495	40.53%
	P GESE	0.340	0.33	0.35	0.07 (20.00)	0	21,501	0.0651	40.05%

December

Strike	Option Symbol	Bid/Ask Mean	Bid	Ask	Change (%)	Volume	Open Interest	Option Value	Implied Vola%
24.0	C GE[illegible]D	4.375	4.30	4.45	-0.25 (-5.10)	[illegible]	83	3.7058	35.11%
	P GE[illegible]D	0.[illegible]	[illegible]	[illegible]98	[illegible]	[illegible]	19	[illegible]5554	30.86%
25.0	C GE[illegible]E	3.650	3.60	3.[illegible]	-0.3 (-9.42)	[illegible]	[illegible]	[illegible].0121	33.37%
	P GEXE	1.240	1.22	1.26	0.15 (12.30)	0	7,866	0.8458	29.73%

Compare implied volatility levels between the two months

Portion of Option Chain
from IVolatility.com

Vega
Dollar Impact
of
Changing Implied Volatility

(also known as Kappa or Omega)

Vega: A Definition

- Vega – one of the “Greeks”
  - sensitivity of option price to change in implied volatility
  - generated by option pricing model
  - theoretical in nature
- Vega quantified
  - expected option price change for 1%-point change in implied
  - expressed in dollars/cents
- How does it work?
  - implied ↑ 1%-point → calls and puts ↑ by vega amount
  - implied ↓ 1%-point → calls and puts ↓ by vega amount

Effect of Vega

- Because it quantifies the effect of implied volatility on an option's price, vega effects are on time value only
- In-the-money options
  - least time value – small dollar and percentage changes
  - more in-the-money, smaller vega
- At-the-money options
  - most time value – largest dollar changes
  - nominally, have largest vega amounts
- Out-of-the-money options
  - all time value – largest percentage changes
  - more out-of-the-money, smaller vega

Where to Find Vega

- Option chains
  - brokerage firm Web sites and quote services
  - *www.optionseducation.org/quotes*
  - sample below for illustrative purposes only

Vega

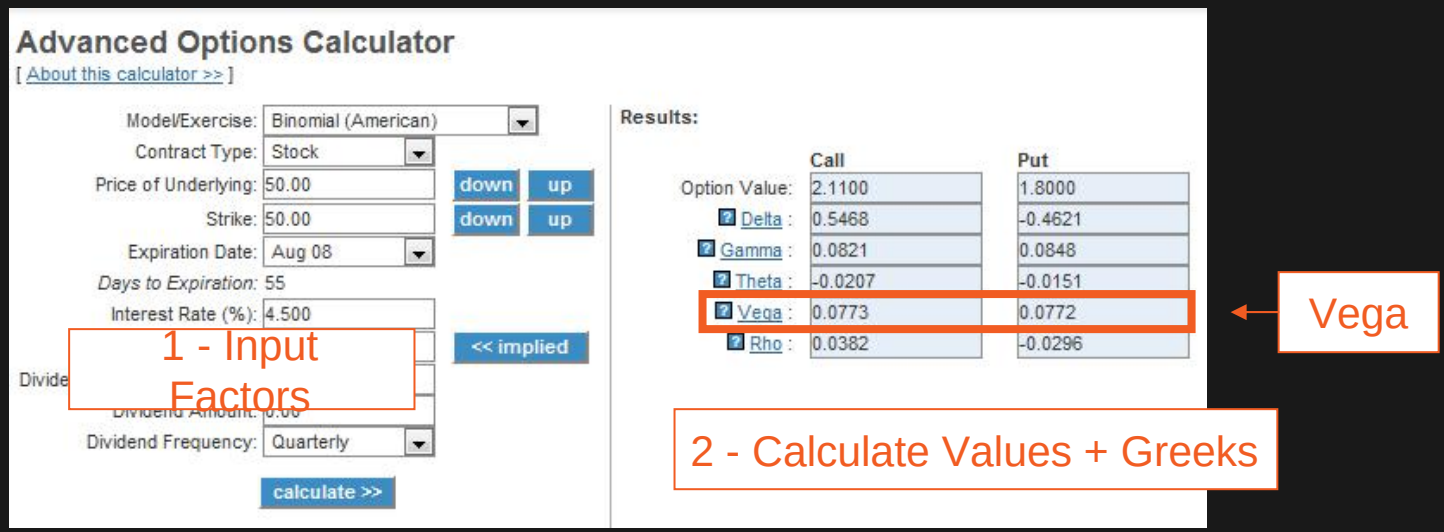
Strike		Option Symbol	Bid/Ask Mean	Bid	Ask	Change (%)	Volume	Open Interest	Option Value	Implied Vola%	Delta	Gamma	Theta	Alpha	Vega	Rho
24.0	C	GEGD	3.650	3.60	3.70	-0.50 (-13.70)	0	50	3.4422	43.69%	0.8744	0.0612	-0.0134	-4.5697	0.0159	0.0161
	P	GESD	0.195	0.19	0.20	0.02 (10.53)	0	1,589	0.0144	41.94%	-0.1169	0.0607	-0.0107	-5.6558	0.0152	-0.0027

Typical option chain on *www.optionseducation.org*

Portion of Option Chain
from IVolatility.com

Where to Find Vega

- Can calculate yourself
  - option pricing calculator online or on your computer
- On *www.optionseducation.org*
  - click “Trading Tools” then “Pricing Calculators”



Portion of Option Chain from IVolatility.com

Vega: Example

- XYZ June 60 call (or put)
  - price = $3.50
  - current volatility = 35%
  - vega = 0.15 ($0.15)

Assuming other pricing factors remain constant:

- Volatility up from 35% to 36%
  - call (or put) price increase $3.50 + 0.15 → $3.65
- Volatility down from 35% to 34%
  - call (or put) price decrease $3.50 – 0.15 → $3.35

More about Vega

- Importance
  - see cash risk from changing implied – dollars/point of volatility
  - can avoid recalculations at various implied levels
  - in periods of unusually high or low volatility – set expectations
- Note
  - vega is entirely theoretical
  - in reality price changes may differ from those predicted by vega
- Other vega facts
  - vega decreases with time
  - stock has zero vega
  - vega can be netted with complex positions (positive vega for long options and negative for short)

Strategies

Implied Effect: Strategies

- At expiration option worth intrinsic value only
  - with expiring options volatility is a moot point
  - all time value gone
  - before expiration changing implied may take you on a ride you're not expecting
- Changes in implied might lead you to exit market early
  - maybe take an early profit (before stock has reached target)
  - maybe cut a loss early (without unfavorable stock move)
  - greedy mode for profits vs. panic mode for losses

Implied Effect: Strategies

- Any long call or put position
  - takes advantage of increase in implied volatility
  - can suffer with decrease in implied
- Any short call or put position (uncovered)
  - takes advantage of decrease in implied volatility
  - can suffer with increase in implied
- The effect of changing implied volatility varies with complex strategies (or those with multiple legs)

Typical Strategies That Want Implied Up

- Long straddles and strangles
  - buying two options – doubly exposed to volatility
  - can profit from implied increase without stock move
  - if implied doesn't increase, need relatively large increase in stock volatility to profit
- Backspreads (call or put)
  - strategy involves buying more options than selling
  - profit from long options should outpace loss on short
- The above strategies carry limited risk

Typical Strategies That Want Implied Down

- Short straddles and strangles
  - selling two options – doubly exposed to volatility
  - can profit from implied and/or stock volatility decrease
- Ratio spreads (call or put)
  - strategy involves selling more options than buying
  - profit from short options should outpace loss on long
  - also want low stock volatility – price to stabilize at short strike
- The above strategies carry unlimited (or very substantial) risk

Mitigate Volatility Risk of Long Call

- Hedge volatility risk of a long call – spread it off
  - sell higher strike with same expiration
  - create a bull call spread (vertical spread)
  - if implied down – loss on long partially offset by profit on short
  - degree of hedge depends on stock price vs. strike prices
  - spreading also cuts downside risk of long call
  - if the stock sits between strikes you might even profit from an implied volatility decrease

Mitigate Volatility Risk of Long Put

- Hedge volatility risk of a long put – spread it off
  - sell lower strike with same expiration
  - create a bear put spread (vertical spread)
- Works like the call spread
  - if implied down – loss on long partially offset by profit on short
  - degree of hedge depends on stock price vs. strike prices
  - spreading also cuts upside risk of long put
  - if the stock sits between strikes you might even profit from an implied volatility decrease

Closing Thoughts

Closing Thoughts

- Understand ramifications of implied volatility
  - vega
  - implications for underlying price variance
- Be familiar with implied volatility behavior
  - factors that can affect it
- When establishing a position
  - know current implied level compared to past levels
  - account for favorable or unfavorable implied changes
- Expect the unexpected
  - implied levels can change abruptly and significantly

Closing Thoughts

- A thorough knowledge of the math and statistics involved with volatility is not a requirement for successful option trading
- The more informed you are about volatility the better your understanding of how the marketplace works, and why option prices can fluctuate as they often do
- Better understanding of volatility can help you select strategies that fit your tolerance for risk from an unfavorable change in volatility
- Better understanding of volatility can help you set expectations for profit that are more likely to be realized

Closing Thoughts

- Predicting volatility behavior is as difficult, or even more so, than predicting underlying stock prices
  - perhaps leave this to market professionals or an advisory service
- If you have absolutely no opinion about volatility
  - you might sell covered options to generate income
  - don’t pay more premium than you can really afford to lose
  - absolutely nothing wrong with being motivated by a well researched target price for an underlying stock
- Difficult question: Use historical or implied volatility as buying guide?
  - unfortunately there is no easy answer to this question

Pricing Models: Use Common Sense

- Pricing models – many versions
  - consider them helpful but by no means 100% accurate
  - don't let a model tell you what to do – let it guide you
  - use your own common sense
  - always understand the risk vs. reward of any strategy
  - always bare in mind your tolerance for risk
- Implied volatilities are at most a "best guess" of future volatility
  - like a theoretical value not always accurate

"Essentially, all models are wrong, but some are useful."

– Attributed to **George E. P. Box**, Professor Emeritus – University of Wisconsin

Thank You for Attending!

www.optionseducation.org

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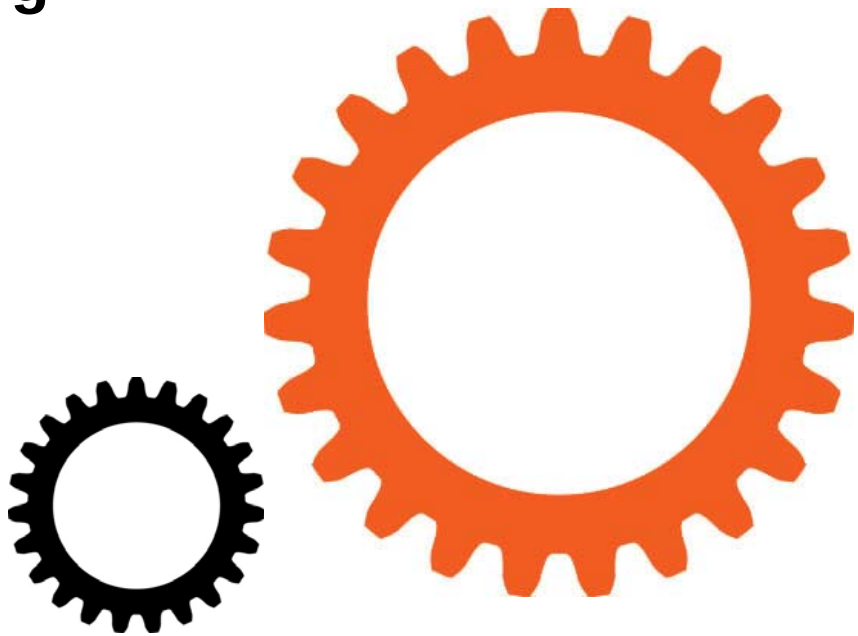

Intermission

After the Break:

- ?