Implied Volatility

Contents

Introduction

Implied volatility is a volatility measure implied through option prices in the market. It is of particular interest to traders as it is one of the only forward-looking volatility measures we have at our disposal and therefore doesn't have to rely on historical price data.

In order to explain how this works, we need to understand a little bit more about options.

The Basics of Options

Options are derivative products that derive their value from an underlying asset. They can be built around a wide-range of underlying assets (or variables), including stocks and indices as well as more obscure assets built around the weather, for example.

A **Call Option** provides the holder with **the right, but not the obligation, to buy an underlying asset** at a *predetermined price* on a *pre-specified date*.

Similarly, a **Put Option** provides the holder with **the right, but not the obligation, to sell an underlying asset** at a *predetermined price* on a *pre-specified date*.

So, these options provide the holder with the opportunity to profit from exercising the option (by buying the underlying asset at less than its current spot value, or selling the underlying asset at more than its spot value) without having the obligation to exercise. Effectively, options deliver a payoff profile which only has upside (as you wouldn't exercise the option if you couldn't profit from doing so).

At the time of expiry, the payoff to the holder of a **call option** will be the underlying asset price at expiry minus the predetermined strike price, and vice versa for the holder of a **put option**.

As an option provides the right, but not an obligation to buy (with a call) or sell (with a put) the underlying asset, the buyer of an option must pay a premium - the price of the option.

Option Pricing

Six factors affect the price of an option:

1. Current underlying asset price (spot price)
2. Strike price (the price you pay for the asset when you exercise the option)
3. Time to expiration
4. Volatility of the asset price
5. Risk-free interest rate
6. Dividend payments

We can consider all of these factors as known parameters, except for volatility, which we have to estimate.

A complicated formula, called the Black-Scholes-Merton option pricing formula, is one of the most common ways of pricing options used by professional traders and it uses the six factors mentioned above. By incorporating the known parameters above into the equation, we can "back-out" an

implied volatility. Note that this volatility is implied by using the above parameters and real option prices on the market, and because the market is forward-looking, we can consider the volatility value that comes out as forward-looking as well.

Choosing Option Data and Volatility Smirks and Smiles

So we know that we can calculate implied volatility from real option data, but beyond choosing options based on the underlying asset we are interested in, how we do we know which option to choose?

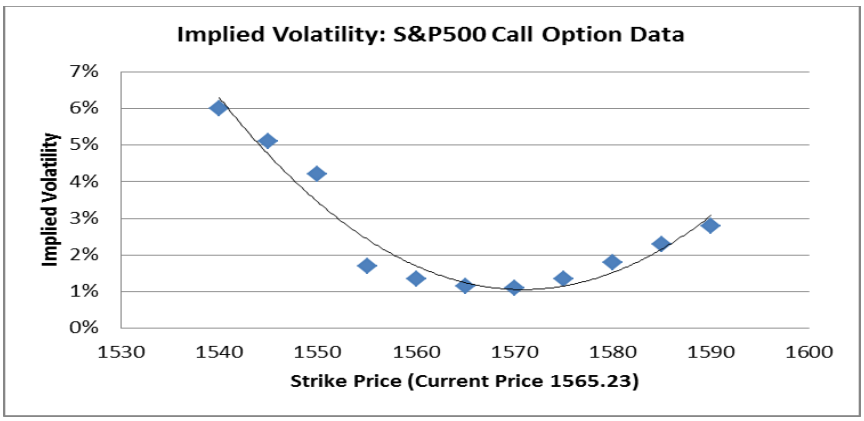
Firstly, this guide and the accompanying spread sheet does not go into how dividends affect our pricing model and hence the implied volatility outputs. For this reason, in order to get an accurate representation of implied volatility, you should choose options on underlying assets that do not pay dividends. Beyond this, maturity dates should represent the timeframe in which you wish to investigate the volatility. For example, an option with one month expiry will imply volatility levels determined by the market that are forward-looking by one month.

Secondly, it should be noted that with all parameters kept constant while varying the strike price, the implied volatilities change. This is due to (Black-Scholes) model inadequacies. Typically, with currencies we get a volatility smile, where implied volatilities are lowest when using strike prices that are "at the money" (equal to the current stock price) and are higher as strike prices get deeper "into or out of the money".

"In the money" call options have strike prices less than the current underlying asset price, meaning that if you exercised the option now you would make a profit. "Out of the money" call options have strike prices that are greater than the current underlying asset price. These payoffs are reversed for put options.

In equities, the story is slightly different and we can observe implied volatilities increasing faster with "in the money" call options compared to those that are "out of the money". Strike prices close to "at the money" values typically still display the lowest implied volatilities.

Below is an example of a volatility "smirk" that is common throughout equities and equity indices. Note that some assets, such as currencies, have more of a "smile" – that means the options that are deeper "out of the money" (to the right hand side on this graph) would have slightly higher implied volatilities much like the "into the money options". In short, the smile is more symmetrical.



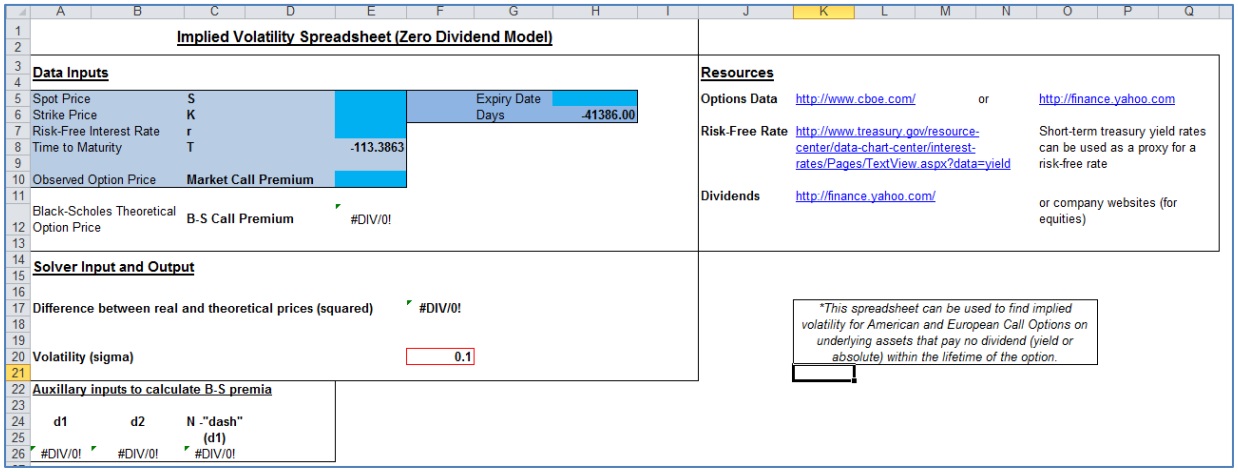
Step-by-Step Guide to Calculating Implied Volatility

In this guide, we use "at the money" (or close to) S&P500 call options, in order to work out implied volatility. This means we will pick options that have a strike price close to the current price of the underlying asset. Note that this choice is arbitrary. You may prefer to use call options with strike prices deeper into the extremities, or to calculate a number of implied volatilities over several strike prices and determine your own average.

- Begin by opening the spreadsheet "Implied Vol" supplied along with this guide.

Note: This spreadsheet can only be used to calculate implied volatility using American and European options on underlying assets that pay no dividends within the lifetime of the option. Furthermore, the sheet is set up to compute implied volatilities from Call Options only.

Describing the Spreadsheet

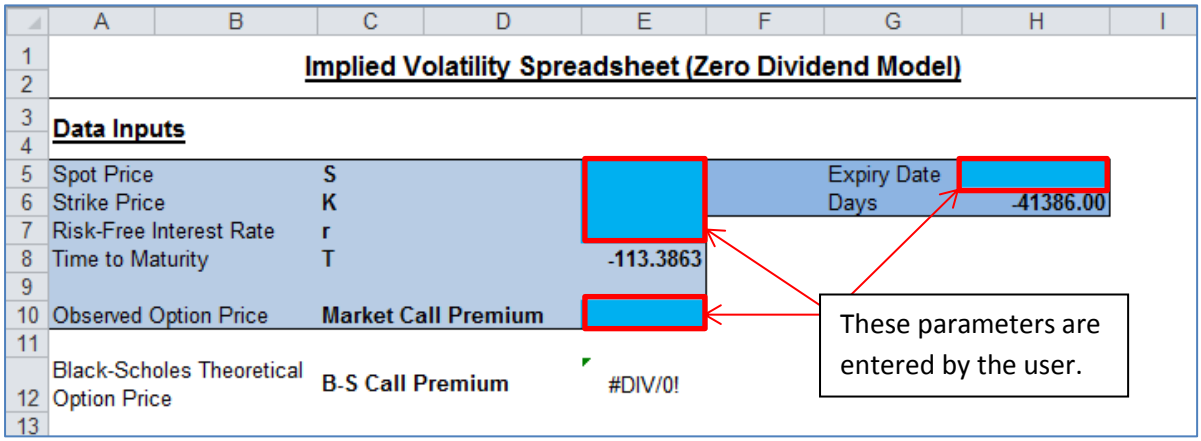


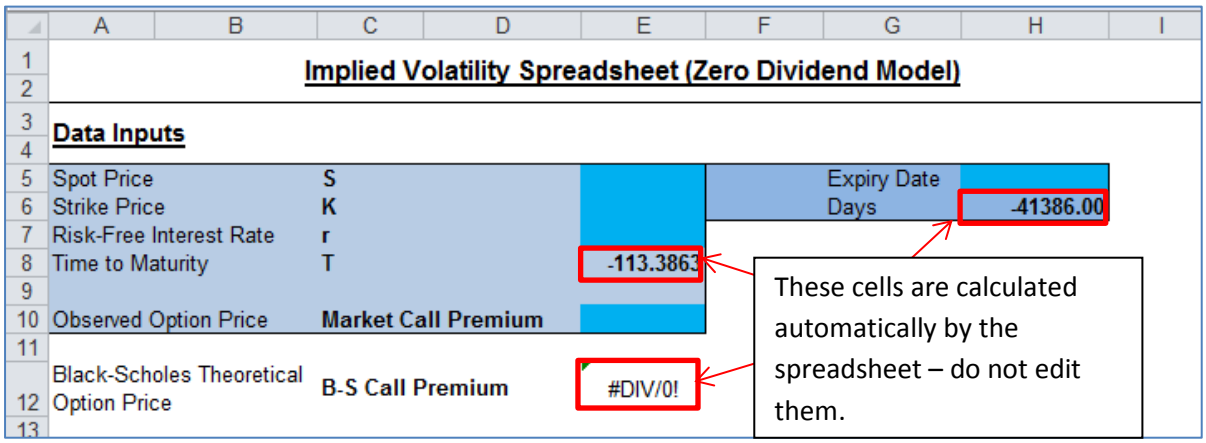
First we will go through the primary section called "Data Inputs". This section gives you a series of variables which you must enter in order to output implied volatility. Cells highlighted in light blue are the only cells that need changing in the spreadsheet.

Data Inputs:

Spot Price	S	The current price of the underlying asset in the market
Strike Price	K	The price at which the holder of the option can buy (if it is a call option) or sell (if it is a put option) the underlying asset at upon exercise.
Risk-free rate	r	The risk-free rate of return. Usually taken as short term government bond yields
Time to maturity	T	The time (in years) until the option expires. In the spreadsheet this is calculated automatically from the number of days until expiry (see "Days")
-	Expiry Date	The option's date of expiry
-	Days	The number of days until expiry from today until the option expires. This is calculated automatically

		in Excel once the expiry date has been entered
Observed Option Price	Market Call Premium	The observed market price of the desired option
Black-Scholes Theoretical Option Price	B-S Call Premium	The theoretical option price given the factors affecting option prices (as previously mentioned) – Using the Black-Scholes-Merton pricing formula



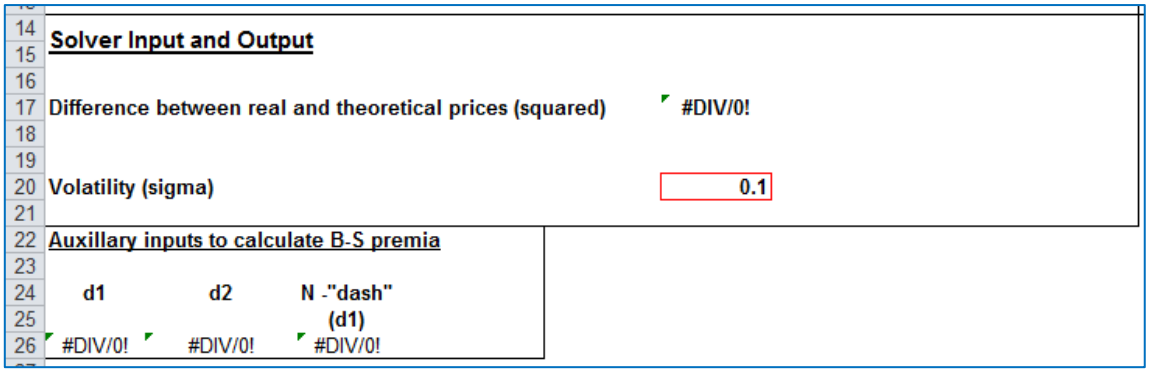


Solver Input and Output:

This section has a cell that calculates the difference between the observed option price in the market and the theoretical Black-Scholes-Merton model price (Cell F17). The idea of this section is to use Excel to conduct an iterative process to find a volatility input into the theoretical model that finds an output price as close as possible to the observed option price in the market. The volatility used is called the implied volatility and this is displayed in cell F20, inside the red box.

Black-Scholes Auxiliary Inputs:

This section provides inputs into the Black-Scholes-Merton equation. These cells should not be manually altered at all.



Resources:

This section will be used to obtain information regarding options and underlying assets so we can correctly calculate implied volatility.

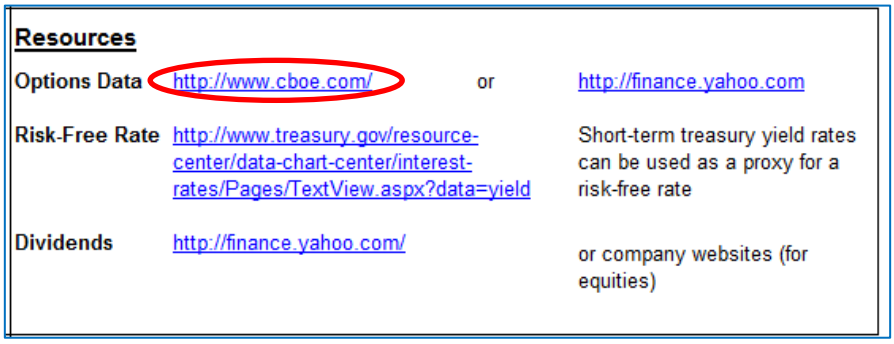
Options Data – Shows where we can find relevant option data to input into the spreadsheet.

Risk-Free Rate – Gives a link to treasury yield rates, from which we can obtain reasonable estimates of a risk-free rate for the US.

Dividends – Provides a link to yahoo finance in order to research whether there may be any dividends on the underlying asset which we are analysing. If there are, we must ensure that the payments do not occur within the chosen option's lifetime. If there are dividend payments before expiry of the option, the implied volatility supplied by the spreadsheet calculations will be inaccurate and so, inadvisable to use.

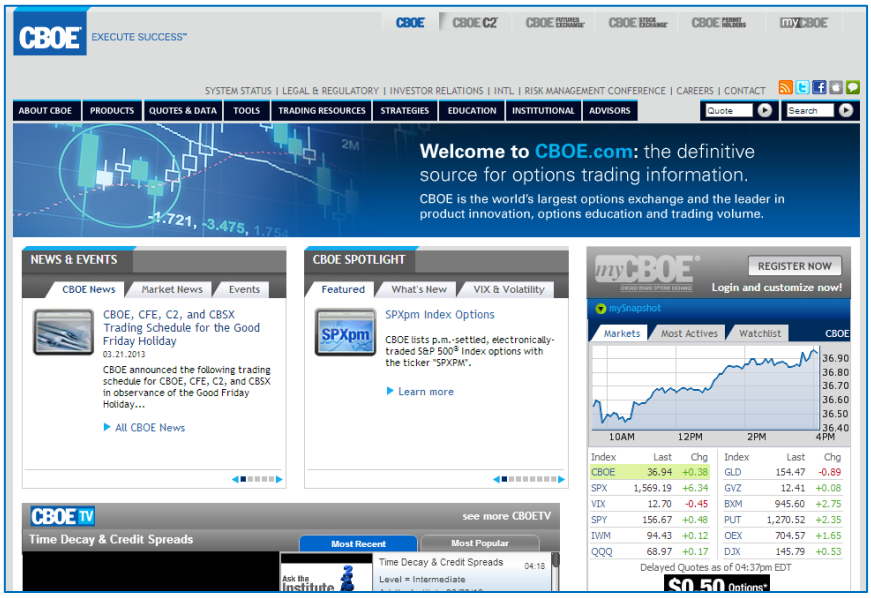
Calculating Implied Volatility (S&P500 example)

- First, click on the link within the spreadsheet to go to the CBOE website.

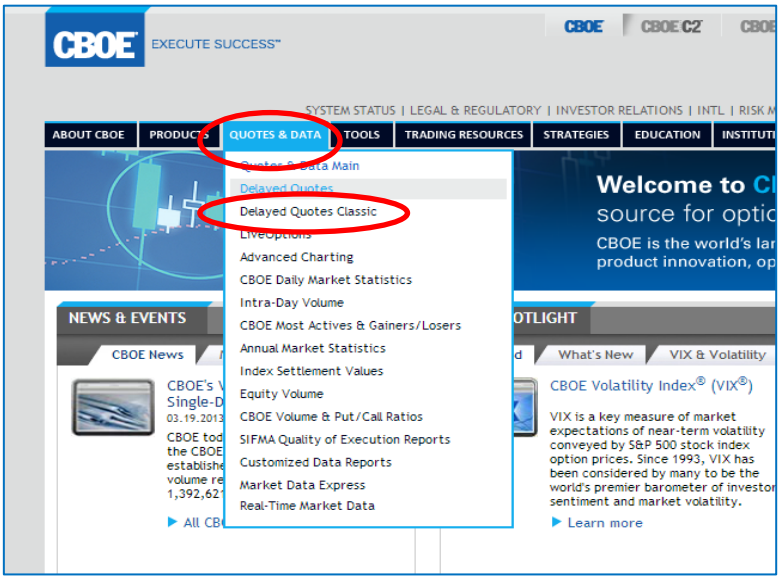


Resources

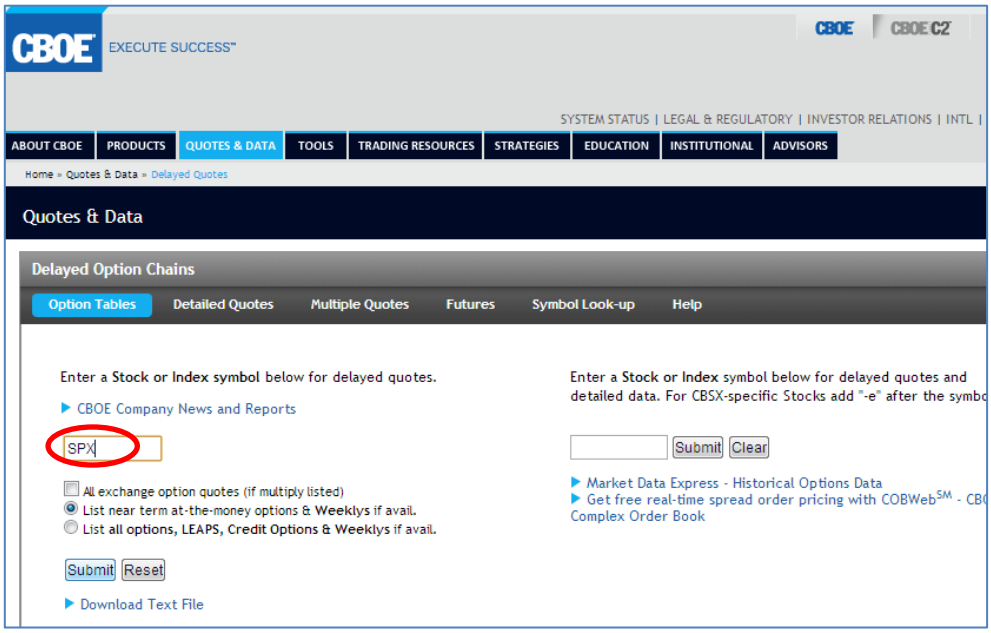
Options Data	http://www.cboe.com/	or	http://finance.yahoo.com
Risk-Free Rate	http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield		Short-term treasury yield rates can be used as a proxy for a risk-free rate
Dividends	http://finance.yahoo.com/		or company websites (for equities)



- Hover over “Quotes and Data” in the top-left of the screen and click on “Delayed Quotes Classic”.



- Next, type “SPX” into the ticker box and hit enter. This will bring up data on the S&P500 index.



SPX (S&P 500 INDEX) **1555.25 0.0**
Apr 22, 2013 @ 05:38 ET

Calls	Last Sale	Net	Bid	Ask	Vol	Open Int		Puts	Last Sale	Net	Bid	Ask	Vol	Open Int
SPXW1326D1175-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1175.00	SPXW1326P1175-E	0.05	0.0	0.0	0.0	0	1475
SPXW1326D1200-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1200.00	SPXW1326P1200-E	0.05	0.0	0.0	0.0	0	1007
SPXW1326D1225-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1225.00	SPXW1326P1225-E	0.05	0.0	0.0	0.0	0	4912
SPXW1326D1250-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1250.00	SPXW1326P1250-E	0.05	0.0	0.0	0.0	0	3887
SPXW1326D1275-E	289.90	0.0	0.0	0.0	0	10	13 Apr 1275.00	SPXW1326P1275-E	0.05	0.0	0.0	0.0	0	5250
SPXW1326D1300-E	262.10	0.0	0.0	0.0	0	31	13 Apr 1300.00	SPXW1326P1300-E	0.05	0.0	0.0	0.0	0	9050
SPXW1326D1310-E	247.80	0.0	0.0	0.0	0	22	13 Apr 1310.00	SPXW1326P1310-E	0.05	0.0	0.0	0.0	0	4970
SPXW1326D1320-E	249.00	0.0	0.0	0.0	0	98	13 Apr 1320.00	SPXW1326P1320-E	0.05	0.0	0.0	0.0	0	2225
SPXW1326D1325-E	244.00	0.0	0.0	0.0	0	85	13 Apr 1325.00	SPXW1326P1325-E	0.05	0.0	0.0	0.0	0	5480
SPXW1326D1330-E	237.80	0.0	0.0	0.0	0	17	13 Apr 1330.00	SPXW1326P1330-E	0.05	0.0	0.0	0.0	0	1077
SPXW1326D1340-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1340.00	SPXW1326P1340-E	0.05	0.0	0.0	0.0	0	891
SPXW1326D1350-E	237.65	0.0	0.0	0.0	0	30	13 Apr 1350.00	SPXW1326P1350-E	0.10	0.0	0.0	0.0	0	7816
SPXW1326D1355-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1355.00	SPXW1326P1355-E	0.15	0.0	0.0	0.0	0	0
SPXW1326D1360-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1360.00	SPXW1326P1360-E	0.10	0.0	0.0	0.0	0	1982

When presented with the options data on the S&P500 it shows us near-term close-to-the-money options (Calls and Puts). Within the option data, we are only interested in the “Calls” data on the left-hand side. Within the “Calls” column, many call option contracts are listed and when we click on any one of those contracts we can obtain more detailed information about that particular option. In order to pick an option to analyse, we need to decide on the expiry date of the option and the strike price we wish to use. The centre column presents both these pieces of data.

- Before continuing, note down the last available underlying asset price (in this case for the S&P500), displayed above the top-right of the options table.
- Enter this price into the “Spot Price” cell in the spreadsheet – cell E5.

SPX (S&P 500 INDEX) 1555.25 0.0
Apr 22, 2013 @ 05:38 ET

Calls	Last Sale	Net	Bid	Ask	Vol	Open Int		Puts	Last Sale	Net	Bid	Ask	Vol	Open Int
SPXW1326D1175-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1175.00	SPXW1326P1175-E	0.05	0.0	0.0	0.0	0	1475
SPXW1326D1200-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1200.00	SPXW1326P1200-E	0.05	0.0	0.0	0.0	0	1007
SPXW1326D1225-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1225.00	SPXW1326P1225-E	0.05	0.0	0.0	0.0	0	4912
SPXW1326D1250-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1250.00	SPXW1326P1250-E	0.05	0.0	0.0	0.0	0	3887
SPXW1326D1275-E	289.90	0.0	0.0	0.0	0	10	13 Apr 1275.00	SPXW1326P1275-E	0.05	0.0	0.0	0.0	0	5250
SPXW1326D1300-E	262.10	0.0	0.0	0.0	0	31	13 Apr 1300.00	SPXW1326P1300-E	0.05	0.0	0.0	0.0	0	9050
SPXW1326D1310-E	247.80	0.0	0.0	0.0	0	22	13 Apr 1310.00	SPXW1326P1310-E	0.05	0.0	0.0	0.0	0	4970
SPXW1326D1320-E	249.00	0.0	0.0	0.0	0	98	13 Apr 1320.00	SPXW1326P1320-E	0.05	0.0	0.0	0.0	0	2225
SPXW1326D1325-E	244.00	0.0	0.0	0.0	0	85	13 Apr 1325.00	SPXW1326P1325-E	0.05	0.0	0.0	0.0	0	5480
SPXW1326D1330-E	237.80	0.0	0.0	0.0	0	17	13 Apr 1330.00	SPXW1326P1330-E	0.05	0.0	0.0	0.0	0	1077
SPXW1326D1340-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1340.00	SPXW1326P1340-E	0.05	0.0	0.0	0.0	0	891
SPXW1326D1350-E	237.65	0.0	0.0	0.0	0	30	13 Apr 1350.00	SPXW1326P1350-E	0.10	0.0	0.0	0.0	0	7816
SPXW1326D1355-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1355.00	SPXW1326P1355-E	0.15	0.0	0.0	0.0	0	0
SPXW1326D1360-E	0.0	0.0	0.0	0.0	0	0	13 Apr 1360.00	SPXW1326P1360-E	0.10	0.0	0.0	0.0	0	1982

	A	B	C	D	E	F	G	H	I
1									
2		**Implied Volatility Spreadsheet (Zero Dividend Model)**							
3									
4		**Data Inputs**							
5		Spot Price	**S**		1555.25		Expiry Date		
6		Strike Price	**K**				Days	-41386.00	
7		Risk-Free Interest Rate	**r**						
8		Time to Maturity	**T**		-113.3863				
9									
10		Observed Option Price	**Market Call Premium**						
11									
12		Black-Scholes Theoretical Option Price	**B-S Call Premium**		#DIV/0!				
13									

Return to the CBOE website and the options data table. The guide continues by looking at S&P500 Call options with expiry May 2013. As users of this guide you will not be able to learn from directly copying this example. Instead, use the method outlined from now onwards to apply it to call options on the S&P500 with an expiry date of your choosing.

- Scroll down to find a call option "close to the money" by clicking on the appropriate contract with a strike price near to the S&P500 index's last price. Ensure that this option has reasonable Volume and/or Open Interest values so we know the option has been reliably priced.
- In this example I choose an option with a strike price of 1550.

SPXW1303E1535-E	27.90	0.0	0.0	0.0	0	82	13 May 1535.00
SPXW1303E1540-E	26.00	0.0	0.0	0.0	0	103	13 May 1540.00
SPXW1303E1545-E	20.30	0.0	0.0	0.0	0	100	13 May 1545.00
SPXW1303E1550-E	18.00	0.0	0.0	0.0	0	8118	13 May 1550.00
SPXW1303E1555-E				0.0	0	1339	13 May 1555.00
SPXW1303E1560-E	12.55	0.0	0.0	0.0	0	373	13 May 1560.00
SPXW1303E1565-E	9.90	0.0	0.0	0.0	0	374	13 May 1565.00
SPXW1303E1570-E	7.70	0.0	0.0	0.0	0	1492	13 May 1570.00
SPXW1303E1575-E	6.10	0.0	0.0	0.0	0	5321	13 May 1575.00
SPXW1303E1580-E	4.26	0.0	0.0	0.0	0	4100	13 May 1580.00
SPXW1303E1585-E	3.01	0.0	0.0	0.0	0	552	13 May 1585.00

Selected Contract

This will load up a page showing you more details on that particular option.

Using this screen we can determine the exact date that the option expires, as well as the price of the option and the strike price. With this information and the S&P500 last price we have obtained 4 out of the 5 inputs we need to calculate implied volatility.

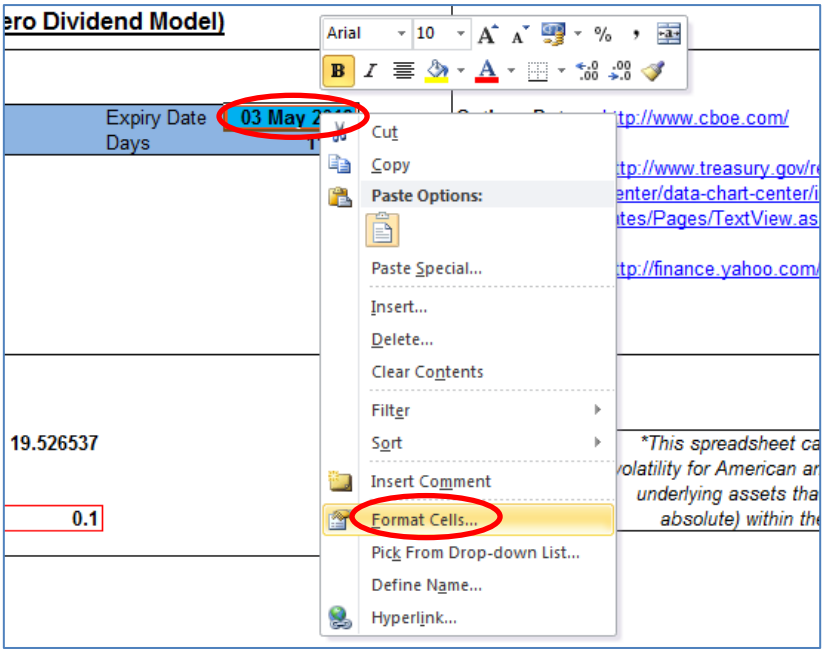
Input those values into the spreadsheet now.

- Input the strike price into cell E6.
- Input the date into cell H5.
- Input the option price into cell E10.

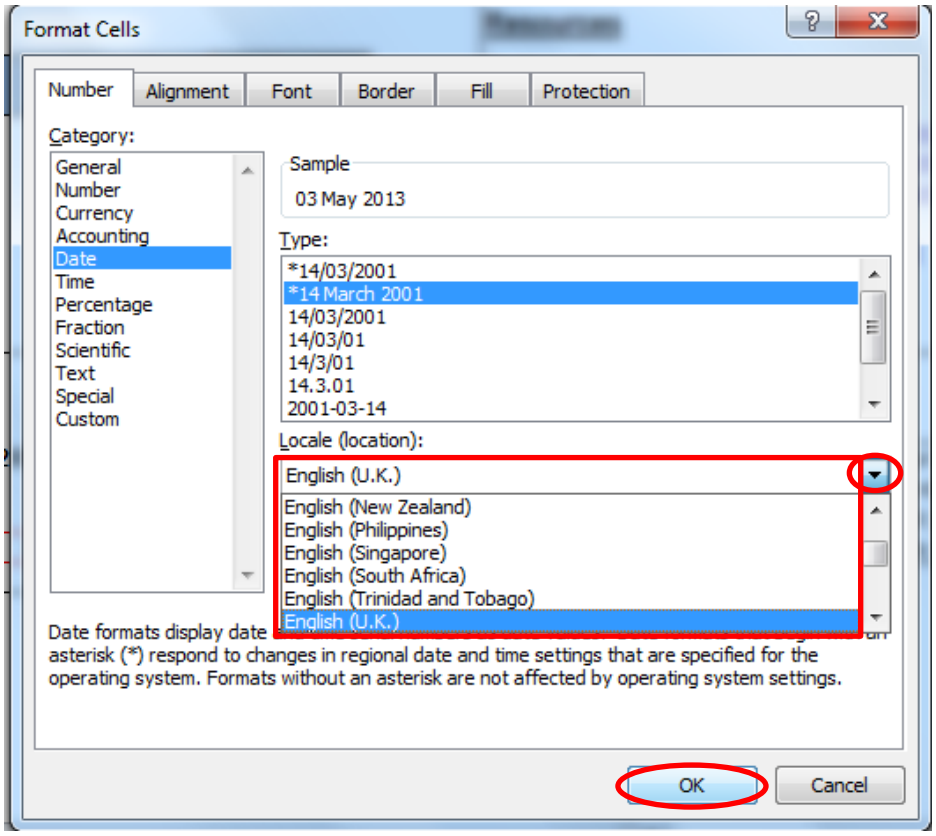
	A	B	C	D	E	F	G	H	I
1				**Implied Volatility Spreadsheet (Zero Dividend Model)**					
2									
3	**Data Inputs**								
4									
5	Spot Price		S		1555.25		Expiry Date	03 May 2013	
6	Strike Price		K		1550		Days	11.00	
7	Risk-Free Interest Rate		r						
8	Time to Maturity		T		0.03013699				
9									
10	Observed Option Price		**Market Call Premium**		18				
11									
12	Black-Scholes Theoretical Option Price		**B-S Call Premium**		13.5811158				
13									

The spreadsheet is configured for dates to be entered in English (UK) format. For those who use a different date format to the British, cell H5 will need to be changed to the local format so that it matches your system clock. Then you will need to enter dates in that format. If you enter the date in British format when your system clock is set to another date format, the spreadsheet calculations will not work.

- To change the date format, right-click on cell H5 and go to “Format Cell”.

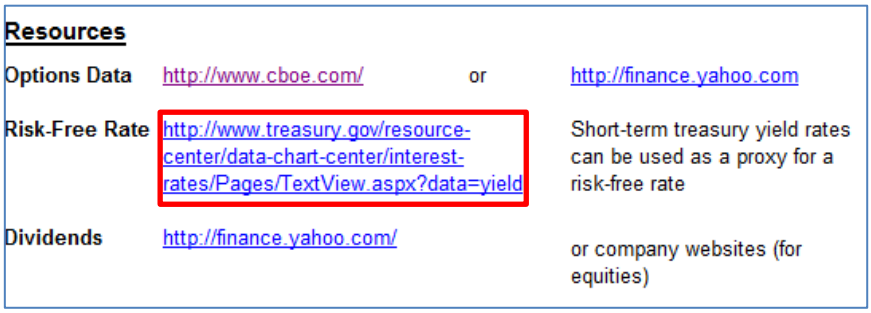


- Select the appropriate location within the date tab, and press OK.



Next we need to find an appropriate risk-free rate to input into the formula. To do this we will go to the Central Bank's website of the country where the asset is listed. From there we will use a government bond/bill rate with a similar maturity to the option we have chosen. Since we are calculating implied volatility from options on the S&P500, we can find a risk-free rate from the US treasury website.

- Use the link in the Resources section of the spreadsheet to navigate to the US treasury daily yield curve rates page. Click on the link provided in the spreadsheet.



In this example, the expiry of the option is in 11 days' time. We can use a one month yield rate from the date roughly one month before our option expires, as offered by the treasury. In this case we use 0.07%. Note that there is not a single correct risk-free rate to use. Any short-term government bill will suffice.

Date	1 Mo	3 Mo	6 Mo	1 Yr	2 Yr	3 Yr	5 Yr	7 Yr	10 Yr	20 Yr	30 Yr
04/01/13	0.06	0.08	0.11	0.14	0.23	0.36	0.76	1.23	1.86	2.70	3.08
04/02/13	0.06	0.07	0.11	0.14	0.25	0.36	0.78	1.26	1.88	2.72	3.10
04/03/13	0.06	0.06	0.10	0.13	0.24	0.34	0.73	1.20	1.83	2.66	3.05
04/04/13	0.07	0.07	0.10	0.13	0.22	0.33	0.69	1.15	1.78	2.60	2.99
04/05/13	0.05	0.07	0.10	0.13	0.24	0.33	0.68	1.12	1.72	2.50	2.87
04/08/13	0.05	0.07	0.10	0.13	0.24	0.34	0.71	1.15	1.76	2.54	2.91
04/09/13	0.06	0.06	0.10	0.13	0.24	0.34	0.70	1.16	1.78	2.57	2.94

- Input this value into the spreadsheet in cell E7.

Implied Volatility Spreadsheet (Zero Dividend Model)

Data Inputs

Spot Price	S	1555.25	Expiry Date	03 May 2013
Strike Price	K	1550	Days	11.00
Risk-Free Interest Rate	r	0.07%		
Time to Maturity	T	0.03013699		
Observed Option Price	**Market Call Premium**	18		
Black-Scholes Theoretical Option Price	**B-S Call Premium**	13.5998865		

Now we are going to use Excel's Solver add-in to set the theoretical option price to match the observed market option price by changing the volatility input only. This will give us our implied volatility.

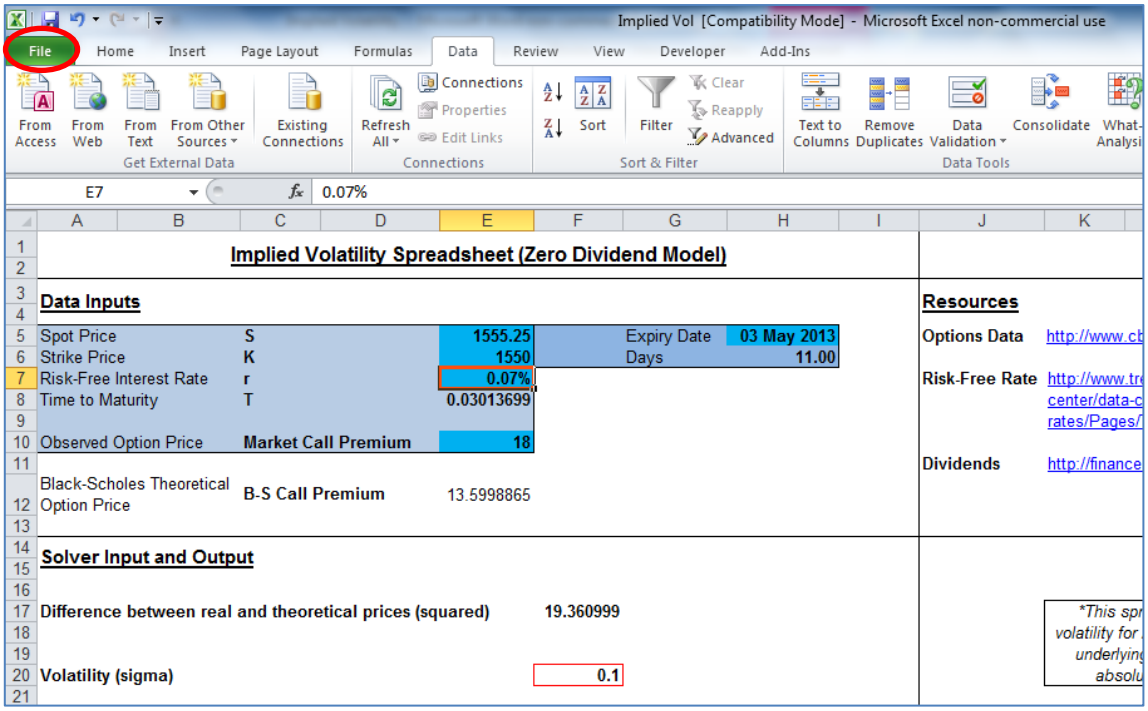
Firstly, we need to install the "Solver Add-In" into Excel - if it isn't already.

For Excel 2003

1. On the Tools menu, click Add-Ins.
2. In the Add-Ins available box, select the check box next to Solver Add-In, and then click OK.
   Tip: if Solver Add-In is not listed, click Browse to locate it.
3. If you see a message that tells you the Solver Add-In is not currently installed on your computer, click Yes to install it.
4. Click Tools on the menu bar. When you load the Solver Add-In, the Solver command is added to the Tools menu.

For Excel 2007, (2010)

1. Click (File)→Options, and then click the Add-Ins category.
2. Near the bottom of the Excel Options dialog box, make sure that Excel Add-ins is selected in the Manage box, and then click Go.
3. In the Add-Ins dialog box, select the check box for Solver Add-In and then click OK.
4. If Excel displays a message that states it can't run this add-in and prompts you to install it, click Yes to install the add-in.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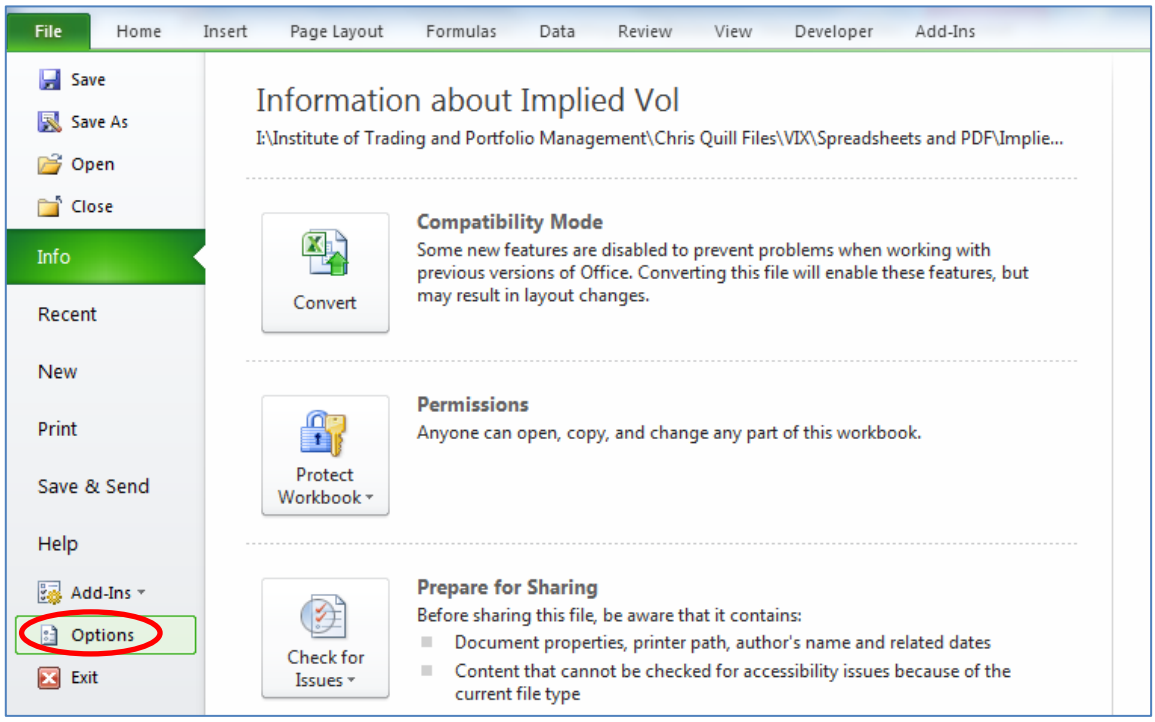
Implied Volatility Spreadsheet (Zero Dividend Model)
Data Inputs
Spot Price S 1555.25
Strike Price K 1550
Risk-Free Interest Rate r 0.07%
Time to Maturity T 0.03013699
Expiry Date 03 May 2013
Days 11.00
Observed Option Price Market Call Premium 18
Black-Scholes Theoretical Option Price B-S Call Premium 13.5998865
Solver Input and Output
Difference between real and theoretical prices (squared) 19.360999
Volatility (sigma) 0.1
Resources
Options Data
Risk-Free Rate
Dividends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Permissions
Anyone can open, copy, and change any part of this workbook.
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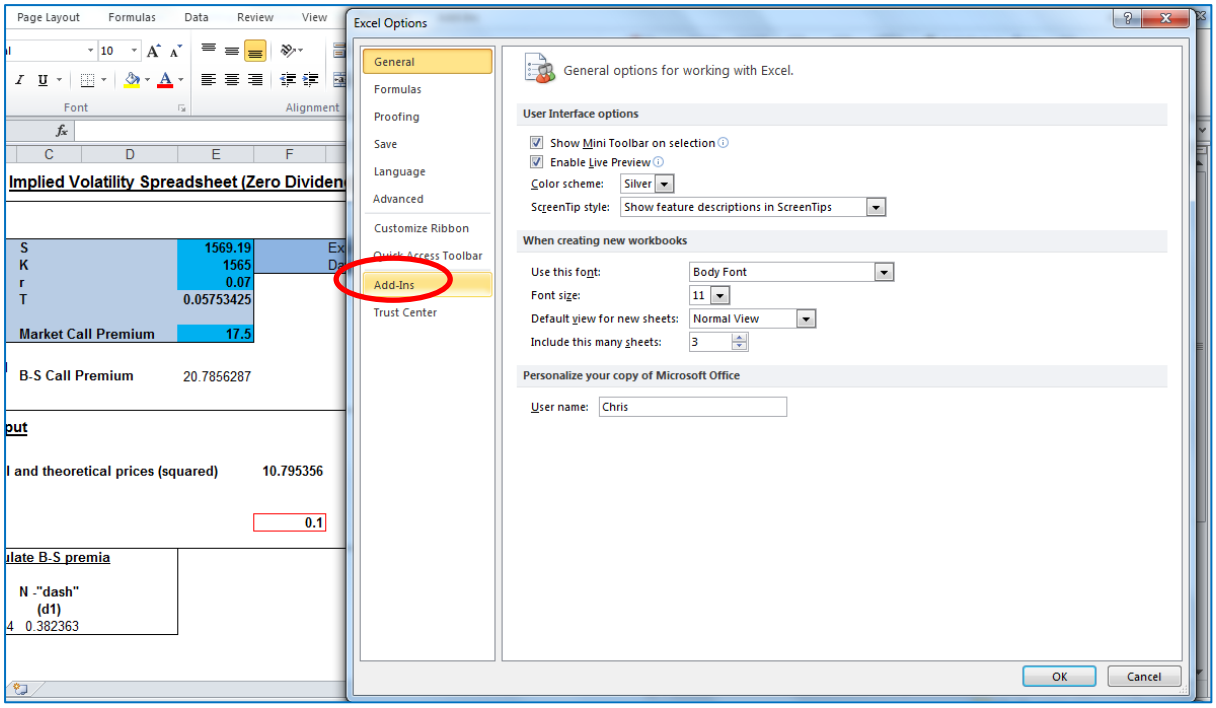
Before sharing this file, be aware that it contains:
Document properties, printer path, author's name and related dates
Content that cannot be checked for accessibility issues because of the current file type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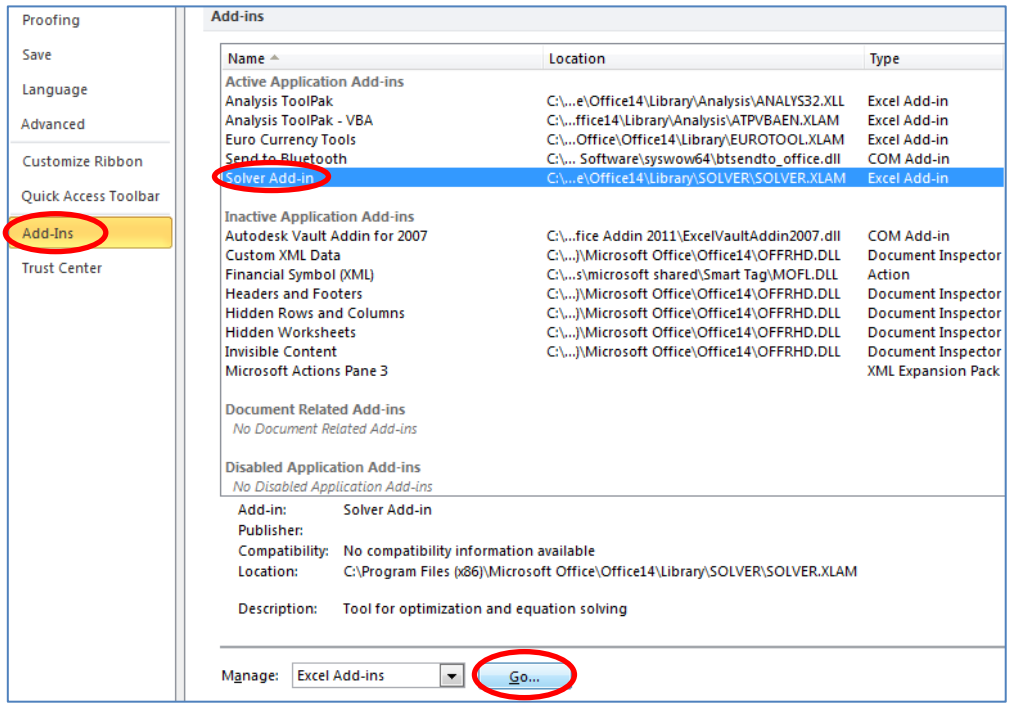
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Document Inspector
Invisible Content
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Document Inspector
Microsoft Actions Pane 3
XML Expansion Pack
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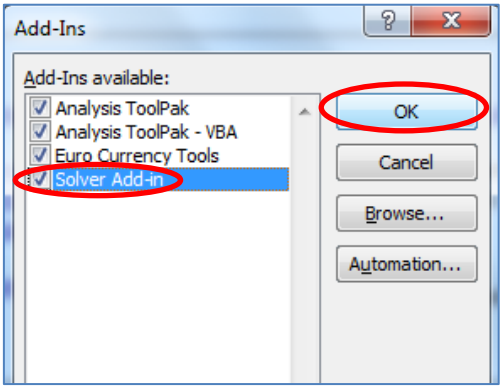
Add-in: Solver Add-in
Publisher:
Compatibility: No compatibility information available
Location: C:\Program Files (x86)\Microsoft Office\Office14\Library\SOLVER\SOLVER.XLAM
Description: Tool for optimization and equation solving
Manage:
Excel Add-ins
Go...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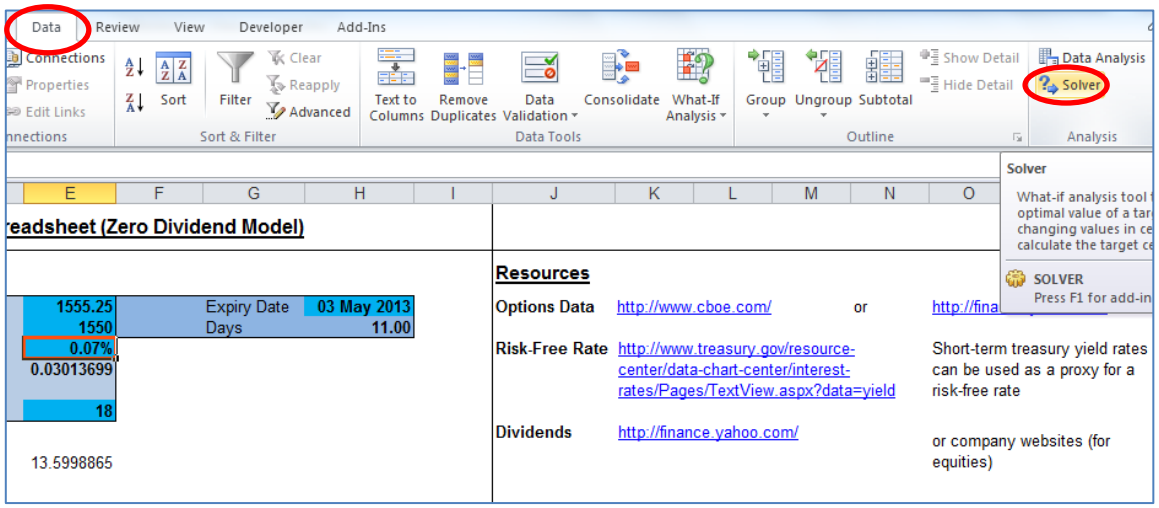
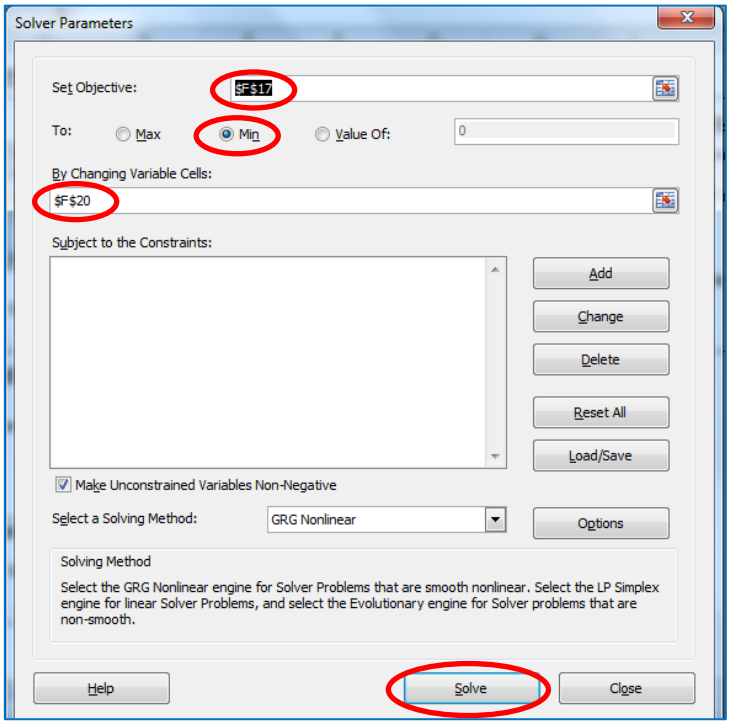
- Now navigate to solver through Data→Solver



Solver should now present a screen like the following.

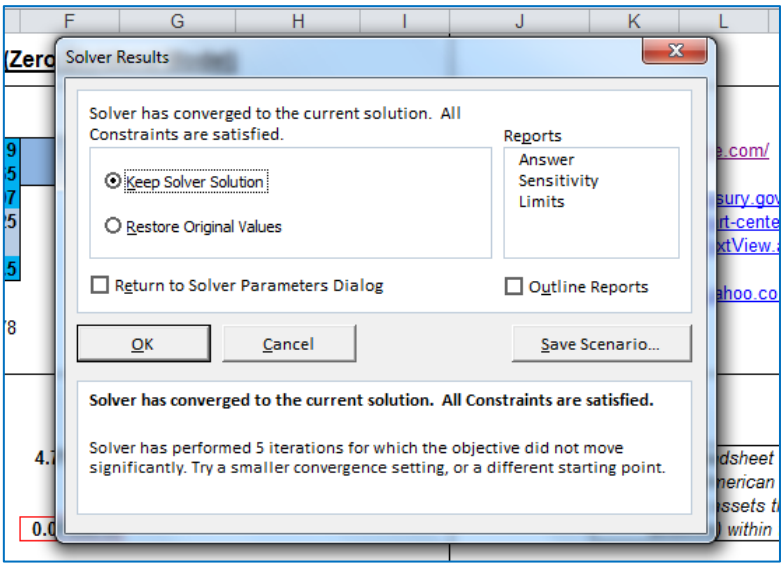


In case the cells are not already entered into the Objective and Variable inputs, take the following steps:

- In the Set Objective input, type “F17”.
- In the By Changing Variable Cells input, type “F20”.
- Set the function to a minimisation procedure by clicking “Min”.
- Now click Solve.

Solver now attempts to use an iterative procedure to minimise the difference between the observed option price and the theoretical option price by changing the volatility input into the theoretical

option price equation. The next window should say that “Solver has converged to the current solution. All constraints are satisfied”.



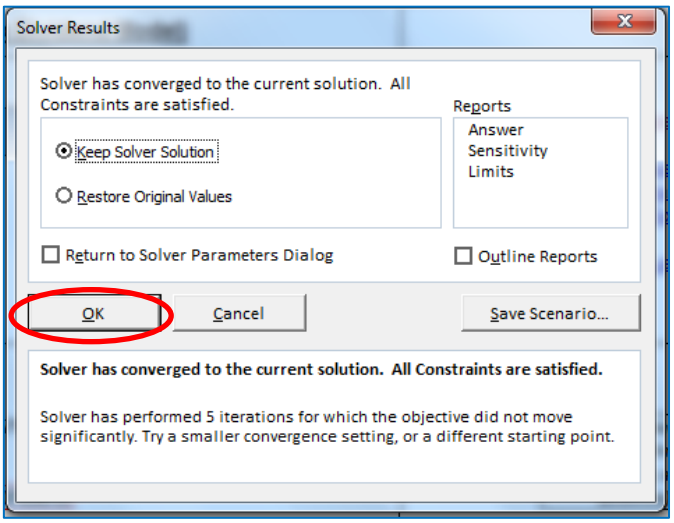
If Solver could not find a solution, take the following steps:

- Change the volatility manually (in the red box) to a value between 0.1 and 0.3 and try again.

Note when changing this volatility we can observe the theoretical B-S option price changes in cell E12 change. Keep changing the volatility until you start to converge the theoretical price (E12) to the observed price (E10). When the values are similar, solver may work in a more robust manner.

- If the above step still does not work, try using a call option with a slightly different strike price.

After Solver is successful we can close the box by pressing OK, and observe the implied volatility in the spreadsheet:



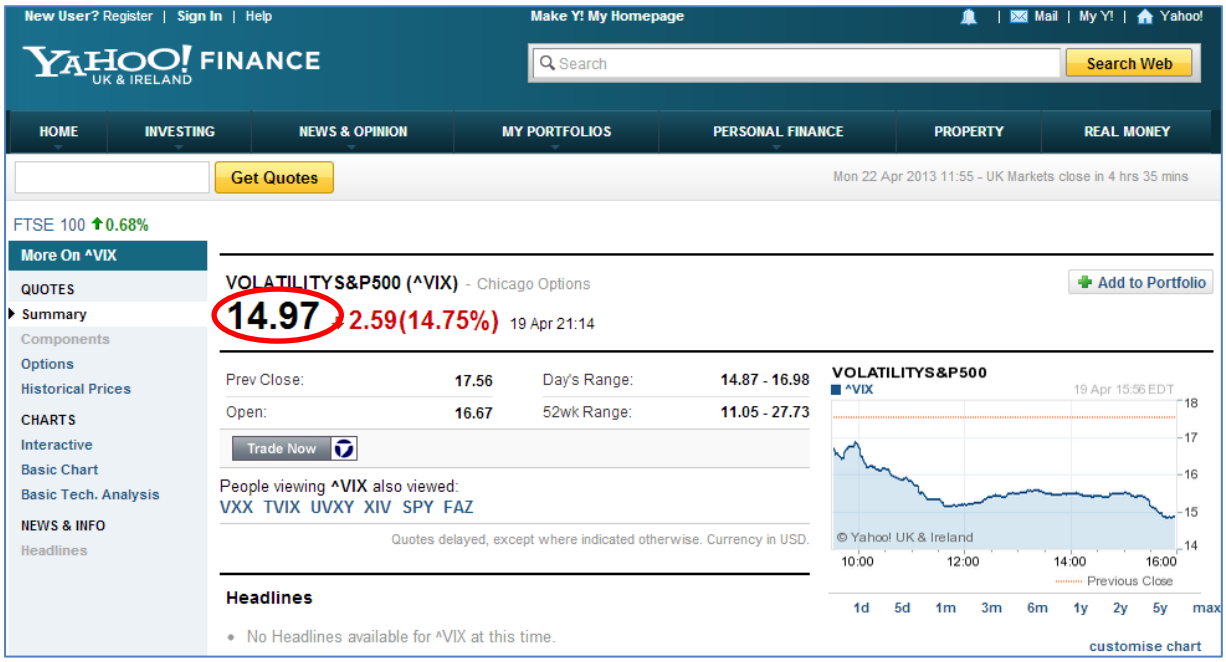
Solver Input and Output

Difference between real and theoretical prices (squared)	1.368E-17
Volatility (sigma)	0.1414821

Implied volatility

In this example we have an implied volatility of 0.14. This is an annualised volatility measure implied by our 11-day forward looking call option. We can compare this value to the VIX (implied volatility also calculated from S&P500 options), and it should be fairly similar. Reasons for slight discrepancies between the VIX and the implied volatility we have calculated here will be down to the method of calculation used in the VIX. The VIX calculates the annualised volatility based on a weighted average of a large number of options with different strike prices and expiry dates. It aims to display 1-month forward looking volatility in an annualised format and **scaled up by 100**. Another reason for deviation from the VIX would be the volatility smirk mentioned at the beginning of the guide. By choosing options close to the money we are going to obtain an implied volatility that is lower than an average implied volatility over a number of different strikes. Let's compare this figure to the VIX now.

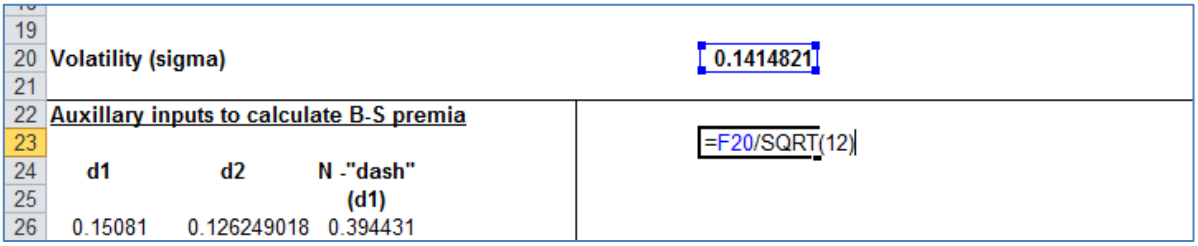
- Go to http://finance.yahoo.com
- Type "VIX" into the Get Quotes box.

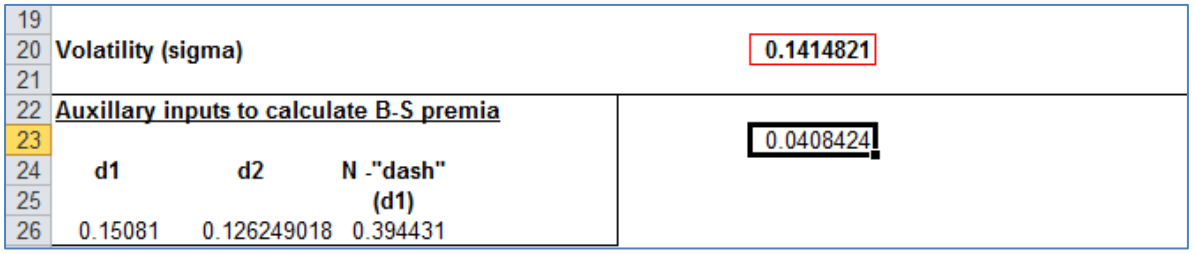


Remember the VIX is displayed by scaling up the annualised volatility by 100. In this example the implied volatility measure has worked particularly well. But remember that we have used one near-the-money option (so we expect a slightly lower implied volatility) and the option is only forward looking by 11 days and not a month as the VIX is.

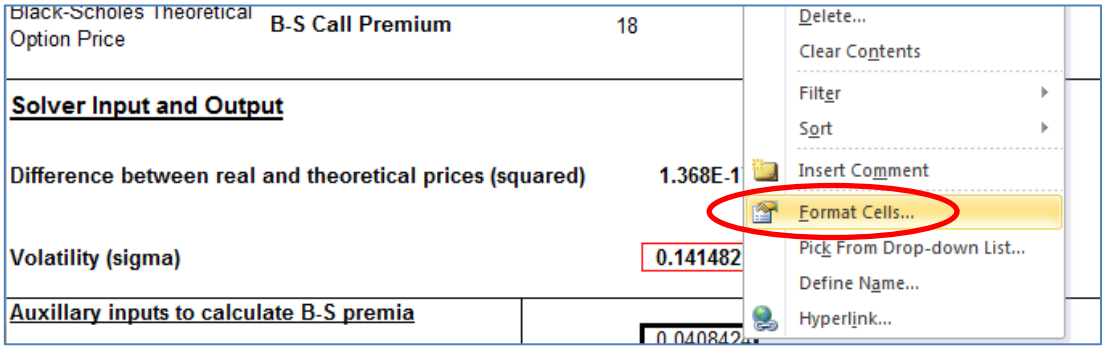
However, we can still use this option to calculate implied standard deviations of the underlying asset returns over different periods. Next, we will transform our implied volatility into a monthly standard deviation measure, which has more practical implications.

- In cell F23 type "=F20/SQRT(12)". Press Enter.

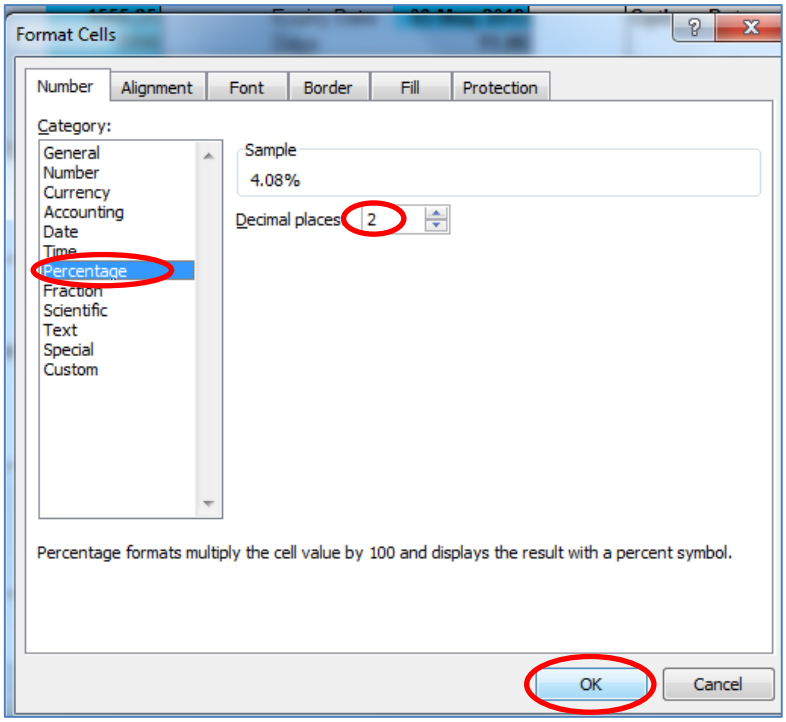




- Right-click on cell F23 and go to "Format Cells".



- Go to the "Number" tab and select "Percentage" as the Category. Display the figure to two decimal places. Press OK.



Solver Input and Output

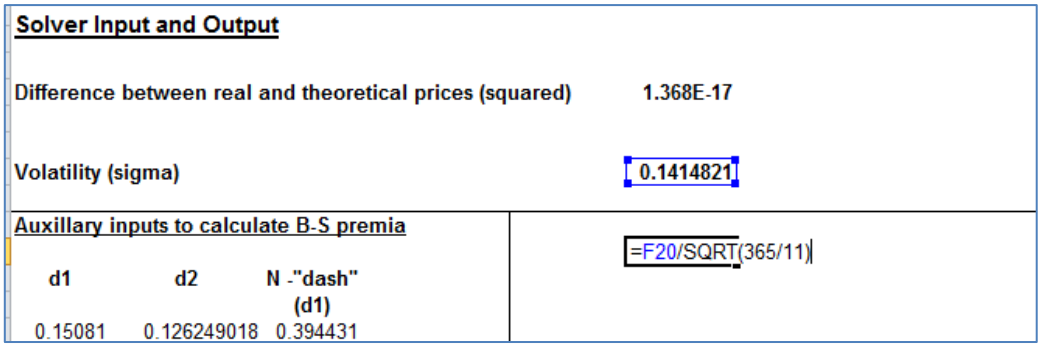
Difference between real and theoretical prices (squared)	**1.368E-17**
Volatility (sigma)	**0.1414821**

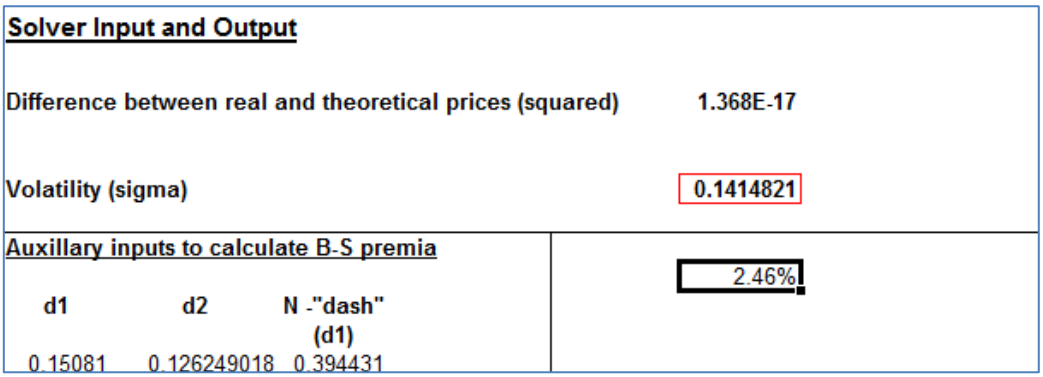
Auxillary inputs to calculate B-S premia			
d1	**d2**	**N -"dash" (d1)**	**4.08%**
0.15081	0.126249018	0.394431	

This finds a one month standard deviation based on our annualised volatility figure. Assuming the returns of the S&P500 are normally distributed (remember the Returns Distribution tutorial) we can take this figure to mean that there is a 68.2% probability that the S&P500 will move by up to 4.08% either side of its average return in the next month. Refer back to the Returns Distribution tutorial to remind yourself of the normal percentage probabilities for 2 and 3 standard deviations either side of the mean. But remember this figure is scaling up from a volatility implied by a 11-day option. Ideally, to obtain a one-month forward looking volatility (and hence standard deviation) measure we would want to use an option with expiry exactly one month from today.

However, in this example we can get true implied volatility estimate of the next 11 days by using this option:

- Change the cell formula to "=F20/SQRT(365/11)"





Assuming normally distributed returns implies:

A Probability Of	That the S&P500 returns within …. Of its average returns in the next 11 days
68.2%	2.46%
95.4%	4.92% (2*2.46%)
99.8%	7.38% (3*2.46%)

Summary

As a forward-looking volatility measure, implied volatility has been shown to more accurately predict future volatility levels than traditional historical returns approaches. This guide has shown how you can calculate your own implied volatilities on given assets, and discussed how to transform them into more meaningful statistics (standard deviations) that you can apply in your portfolio management techniques. More importantly, implied volatility gives an idea of our future trading opportunities and will be the first-move volatility indicator at our disposal that helps us decide between shorter term trading strategies against longer term portfolio management approaches.