

The Standard Deviation (or volatility)

Forget options for a moment. Let's just talk about the concept of volatility. We all know what the term means, right? Simply put, an asset with high volatility moves up and down a whole lot more than an asset with low volatility. But how do we measure it and how do we express it?

Volatility is measured using **standard deviations**. Standard deviations measure the average movement of an instrument around its average price. The standard deviation is expressed as a percentage.

As an options trader, you do not need to physically calculate volatility or standard deviations. Software does that for you. However it is highly advisable that you at least understand how it is calculated.

A simple example

Over a five day period, XYZ trades at the following prices:

Day 1	Day 2	Day 3	Day 4	Day 5
\$50	\$52	\$48	\$50	\$53

From this we can measure the average price for that period and the standard deviation of these price movements.

Firstly to calculate the average price, add up all prices and divide by the number of days:

$$(50 + 52 + 48 + 50 + 53) / 5 = \$50.60$$

To calculate the standard deviation takes a few steps. Firstly, we calculate the difference between each daily price and the average price:

	Day 1	Day 2	Day 3	Day 4	Day 5
Price	50	52	48	50	53
Less average	50.60	50.60	50.60	50.60	50.60
Difference	-0.60	1.40	-2.60	0.60	2.40

Then we take the square of each difference (this removes the negative or positive bias):

	Day 1	Day 2	Day 3	Day 4	Day 5
Difference	-0.60	1.40	-2.60	0.60	2.40
Square	0.36	1.96	6.76	0.36	5.76

Averaging the squared figures and taking the square root of that average gives the standard deviation:

$$\begin{aligned}\text{Standard deviation} &= \sqrt{(0.36+1.96+6.76+0.36+5.76)/5} \\ &= \sqrt{(15.2/5)} \\ &= \$1.74 \text{ approx}\end{aligned}$$

So what does this \$1.74 mean? What can we do with it? With a standard deviation, we can estimate how far a price will deviate from its average and the probability of that movement.

The general rules of thumb for interpreting a standard deviation:	
67%	of the time the price will deviate within one standard deviation from its average price
95%	of the time the price will deviate within two standard deviations of its average

So, in our example, 67% of the time the price will deviate within plus or minus \$1.74 from the average price of \$50.60. That is, 67% of the time the price will stay within the range of \$48.86 and \$52.34.

Also, 95% of the time, the price will deviate within plus or minus \$3.48 (2 times \$1.74) from the average price. That is, 95% of the time the price will stay within the range of \$47.12 and \$54.08.

Sometimes, people like to express the standard deviation as a percentage of the average price:

$$1.74 / 50.60 = 3.44\%$$

This is in fact how options traders express volatility, so we should get used to the idea of percentages.
