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OCC

The Relative Value Framework

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OCC

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The Relative Value Framework

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Core Functions



Issuance + Guarantee
of U.S. Listed Contracts



Clearing + Settlement



Risk Management

2021 Performance Highlights

9.93B

CONTRACTS CLEARED

\$225B

MARGIN HELD AT YEAR END

39.4M

AVERAGE DAILY VOLUME

\$16.2B

CLEARING FUND HELD AT YEAR END

Products We Clear



Options



Futures



Securities
Lending

Participant Exchanges

16

OPTIONS
EXCHANGES

2

FUTURES
EXCHANGES

1

STOCK LOAN ALT.
TRADING SYSTEM

As December 31, 2021

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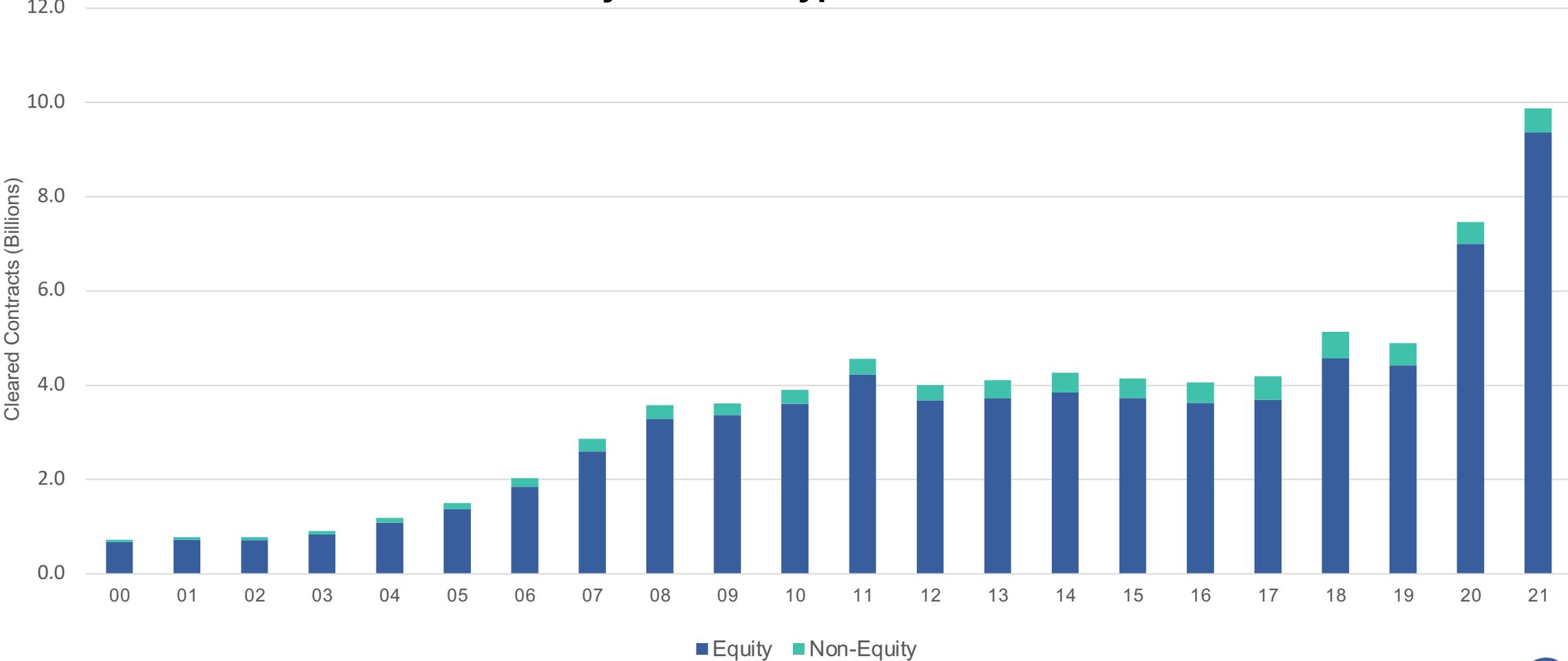
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Annual Options Volume 2000-2021

OCC Annual Contract Volume by Contract Type



Presentation Outline

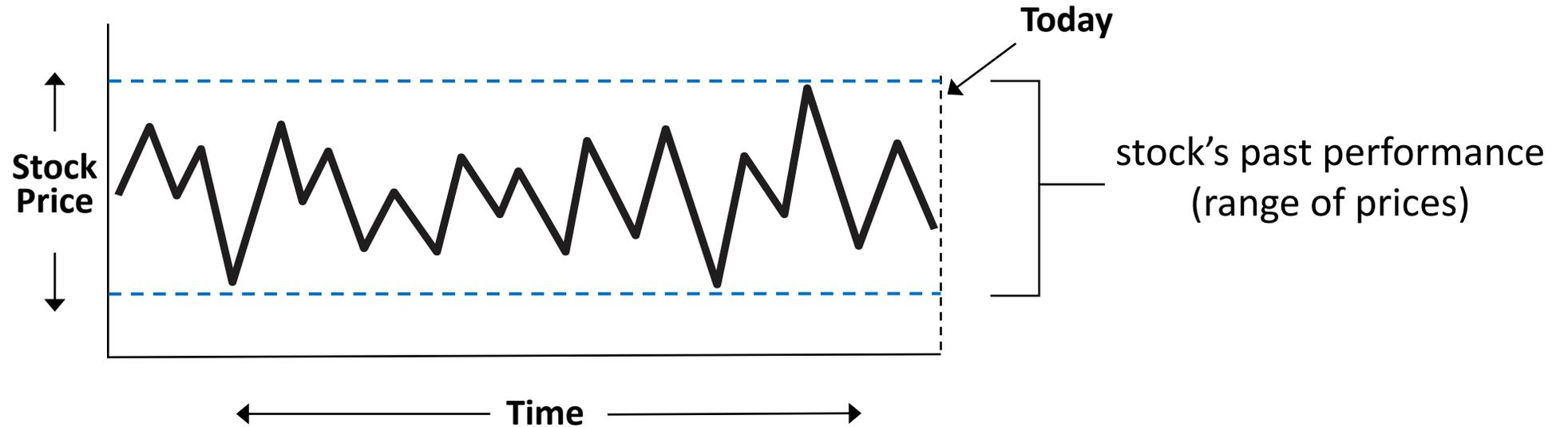
- Historical vs. Implied Volatilities
- What is Relative Value
- Volatility Ratios and how to interpret them
- Ratios over Time / How they might move
- Possible Bumps in the Road



Historical vs. Implied Volatility Metrics



Historical Volatility

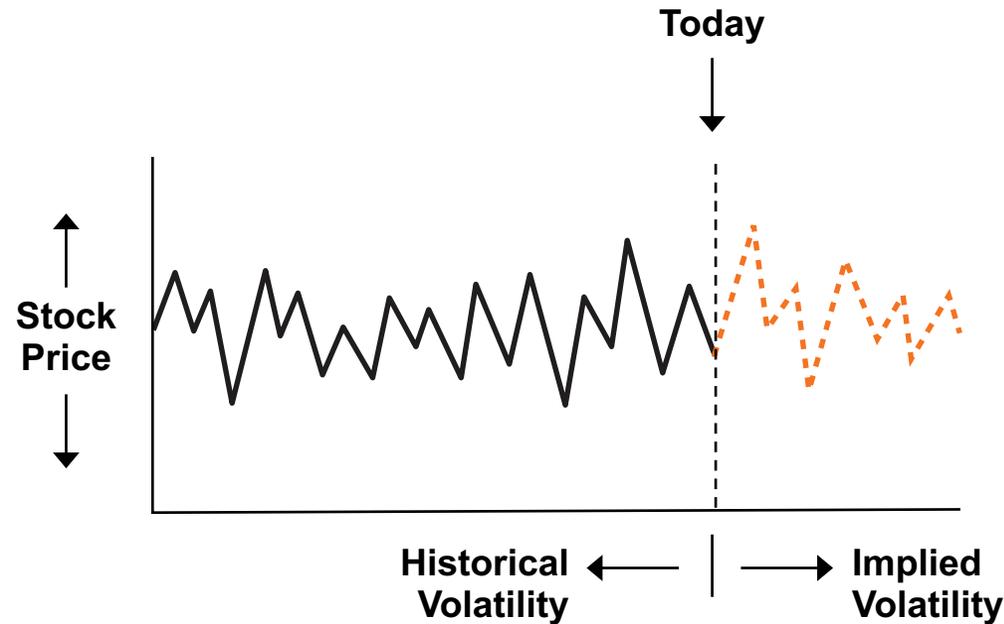


- A stock's previously delivered volatility
 - Can be observed and quantified (backward looking)
 - This is "historical" volatility
 - A statistic, or a fact, not a prediction or a forecast

Implied Volatility: Definition

- Only options have implied volatility
 - Main input for all option pricing models
 - Reflects current forecasted volatility assumptions with respect to current underlying price and movement
- Reflects the marketplace's current forecast for underlying stock's future volatility
 - Consensus of all market participants
 - Dynamic input into options prices – constantly moving.

Implied Volatility Represents the Future



- Option implied volatility reflects current expectations of future stock volatility (forward looking)

What is Relative Value?



Relative Value: A Definition In Volatility Terms

- A Framework to evaluate Historical and Implied Volatilities against each other
 - Generally expressed as a mathematical ratio (*Implied Vol* \div *Historical Vol*)
 - Simplicity of the concept allows for many use-cases.
- Resultant ratio is always expressing one asset in terms of another asset. Its power is in its reductive potential.
 - Can be used to compare Implied Vol to Historical Vol or Implied to Implied.
 - Can be used to compare assets and Volatilities across asset classes as well.
 - Takes away absolute value bias by expressing everything as a ratio.

Building a Picture of Forecasted and Actual Underlying Movement using Historical and Implied Volatility

Implied Volatility	10 – day Implied Volatility	30 – Day Implied Volatility	60 – Day Implied Volatility	90 – Day Implied Volatility
Stock #1	65.00%	35.25%	22.00%	17.00%
Stock #2	16.25%	16.50%	17.00%	17.25%



Historical Volatility	10 – day Historical Vol	30 – day Historical Vol	60 – day Historical Vol	90 – day Historical Vol
Stock #1	58.00%	30.25%	20.05%	12.00%
Stock #2	15.00%	16.25%	16.00%	15.50%



Implied/Historical Volatility Ratio	10 – day Ratio	30 – day Ratio	60 – day Ratio	90 – day Ratio
Stock #1	1.12	1.16	1.09	1.41
Stock #2	1.08	1.01	1.06	1.11

This suggests the Market is forecasting Stock #1 to have a very distinct curve to its Volatility profile (more movement now / less movement later)

While Stock #2 Implied Volatility Curve looks much more placid – forecasting a similar amount of movement throughout, regardless of duration.

The Historical Volatility numbers tell a similar story here – Stock #1 has much more movement in the 10 – day Historical Numbers than in the 90 – day set. Meaning it has been moving more lately than during it’s longer duration set of data.

While Stock #2 has much less variance in its shape and a more narrow range of values.

When you express these volatility numbers as ratios, the ratios themselves start to tell their own story.

It’s not always evident in looking at the individual volatility numbers on their own – What could a higher ratio value tell you vs. a lower ratio value?

Interpreting the Ratios: What can they tell you?

Example #1	30 – day Implied Vol	30 – day Historical Vol	30 – day Implied / Historical Ratio
Stock #1	20.25%	15.00%	1.35
Stock #2	58.00%	42.9%	1.35



135 %

Implied Volatility is OVER Historical Volatility

Example #2	30 – day Implied Vol	30 – day Historical Vol	30 – day Implied / Historical Ratio
Stock #1	19.50%	25.00%	0.78
Stock #2	73.00%	93.00%	0.78



78 %

Implied Volatility is UNDER Historical Volatility

Example #3	30 – day Implied Vol	30 – day Historical Vol	30 – day Implied / Historical Ratio
Stock #1	15.50%	15.00%	1.03
Stock #2	75.00%	72.75%	1.03



103 %

Implied Volatility is roughly EQUAL to Historical Volatility

Interpreting the Ratios: What can they tell you?

Example #1	30 – day Implied Vol	30 – day Historical Vol	30 – day Implied / Historical Ratio
Stock #1	20.25%	15.00%	1.35
Stock #2	58.00%	42.9%	1.35

These metrics can be interpreted as Implied Vol trading higher than the commensurate duration historical volatility. Some people would term this as options being expensive relative to historical vols. One possible explanation for this relationship would be a forecasted event on the horizon that has raised Implied levels above their Historical Delivered counterparts.

No matter what word you use to describe this current relationship – the volatility metrics expressed as a ratio tells you something about how it lines up – the Implied Volatility is 135% of the Historical Volatility metric for that same duration.

Interpreting the Ratios: What can they tell you?

Example #2	30 – day Implied Vol	30 – day Historical Vol	30 – day Implied / Historical Ratio
Stock #1	19.50%	25.00%	0.78
Stock #2	73.00%	93.00%	0.78

These sets of metrics tell the same story in an inverse way to Example #1. The Implied volatility metrics are below the historical volatility metrics. One possible explanation is the underlying has experienced a previous period of elevated Delivered Volatility, but the market is forecasting a resolution to that period, and thus a lower volatility metric for the next 30 days.

Notice that the ratio of the two volatility numbers can generate the same value (.78 in this case) regardless of their individual levels – Stock #1 and #2 have the same value for their resultant ratio, but vastly different overall Vol levels – this speaks again to the reductive nature of the ratio as a method of expression.

Interpreting the Ratios: What can they tell you?

Example #3	30 – day Implied Vol	30 – day Historical Vol	30 – day Implied / Historical Ratio
Stock #1	15.50%	15.00%	1.03
Stock #2	75.00%	72.75%	1.03

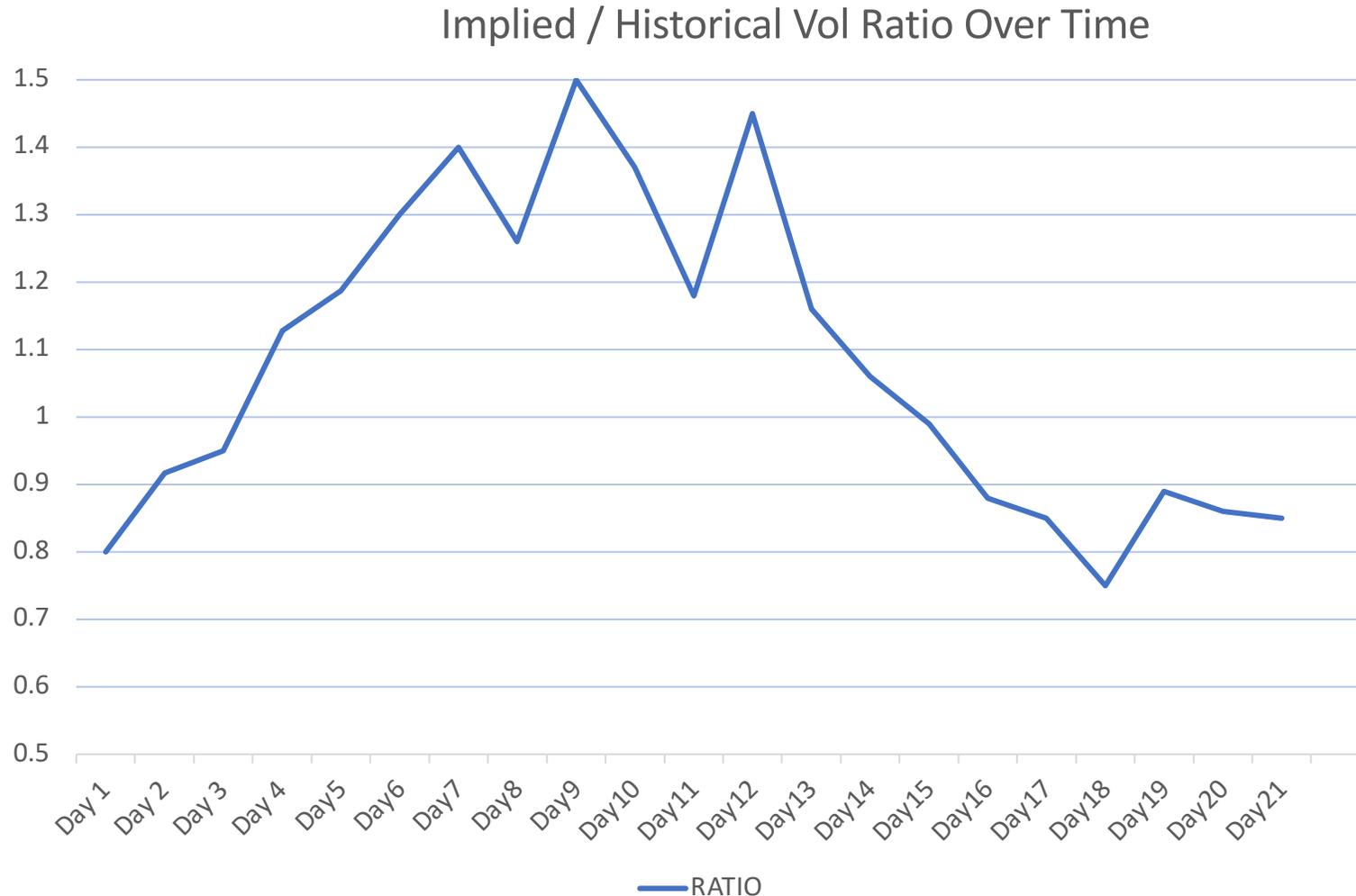
The final ratio from Example #3 tells a story of an Implied Volatility number that very closely relates to the associated Historical Volatility number over a period of time. These situations can occur when Option volatility metrics and Historical metrics are closely linked.

Again, notice that the ratio of the two volatility numbers can generate the same value (1.03 in this case) regardless of their individual levels – Stock #1 and #2 have the same value for their resultant ratio, but vastly different overall volatility levels – This gives you an idea of how the two numbers are related in a relative sense – how you can characterize the relationship – again a vastly different way to look at two stocks that have completely different Implied Volatility metrics.

The Implied Volatility Ratio Over Time



How you can Track the Ratio Over Time



Just like any metric, you can graph these ratios and look at them over time.

What does this say about the last 20 days of Implied / Historical Vol?

The ratio rallied for the first 10 days and sold off for the next 10 days, but how did it move? And Why?

Additionally, sometimes a little more perspective goes a long, long way.....

How you can Track the Ratio Over Time

Implied / Historical Vol Ratio Over Time



In some ways, you can view these ratios much like you view stock charts.....

However, in order to fully understand the nature of the movement, it requires some investigation as to which part of the equation is causing the movement. Is it the numerator, or the denominator?

Movement in the Ratio Explained

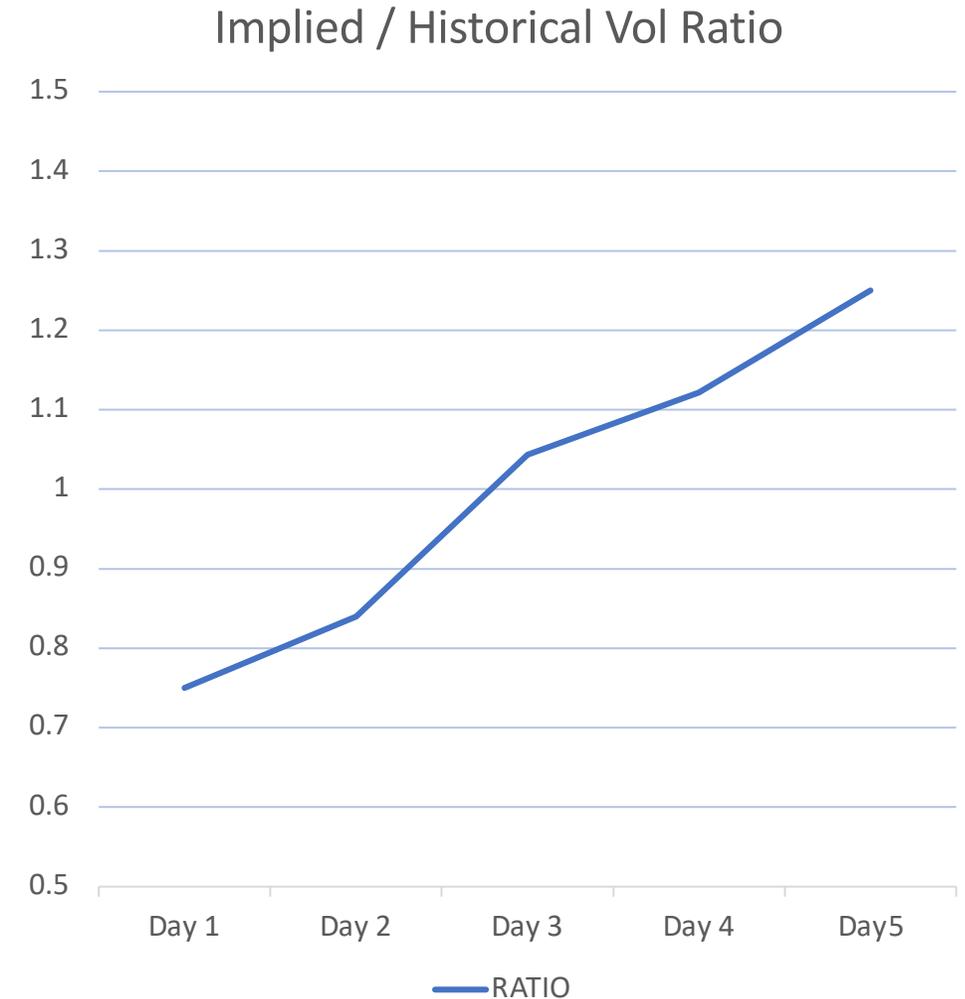
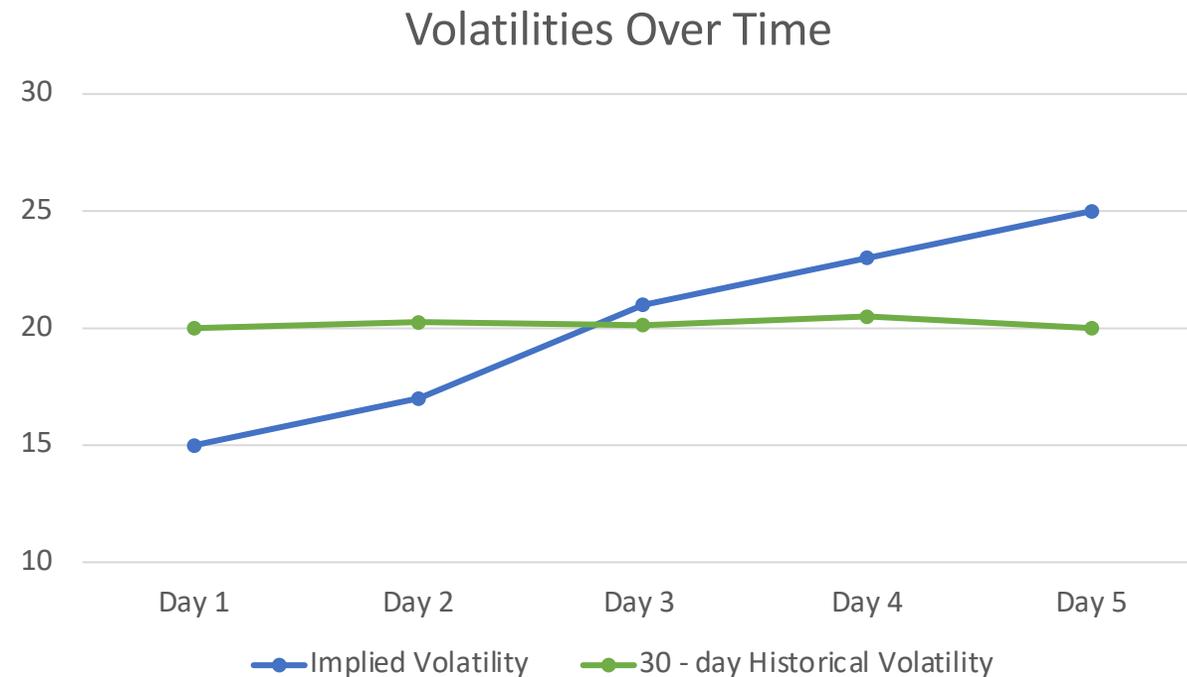


How and Why can the Ratio Move?

- Because of the nature of the ratio as a mathematical function, there can be multiple explanations for directional movement of the metric.
- A move **UP** in the ratio does not always indicate a move up in the numerator (Implied Volatility) and a move **DOWN** does not always indicate the opposite.
 - Multiple possible ways the ratio can move **UP**
 - Numerator (Implied Vol) Moves Higher / Denominator (Historical Vol) stays static
 - Numerator (Implied Vol) Stays Static / Denominator (Historical Vol) dips in value
 - Both metrics move, but the numerator (Implied Vol) moves higher relative to its denominator
 - Multiple possible ways the ratio can move **DOWN**
 - Numerator (Implied Vol) Moves Lower / Denominator (Historical Vol) stays static
 - Numerator (Implied Vol) Stays Static / Denominator (Historical Vol) moves up in value
 - Both metrics move, but the numerator (Implied Vol) moves lower relative to its denominator

How the Ratio Can Move UP – Implied Volatility UP

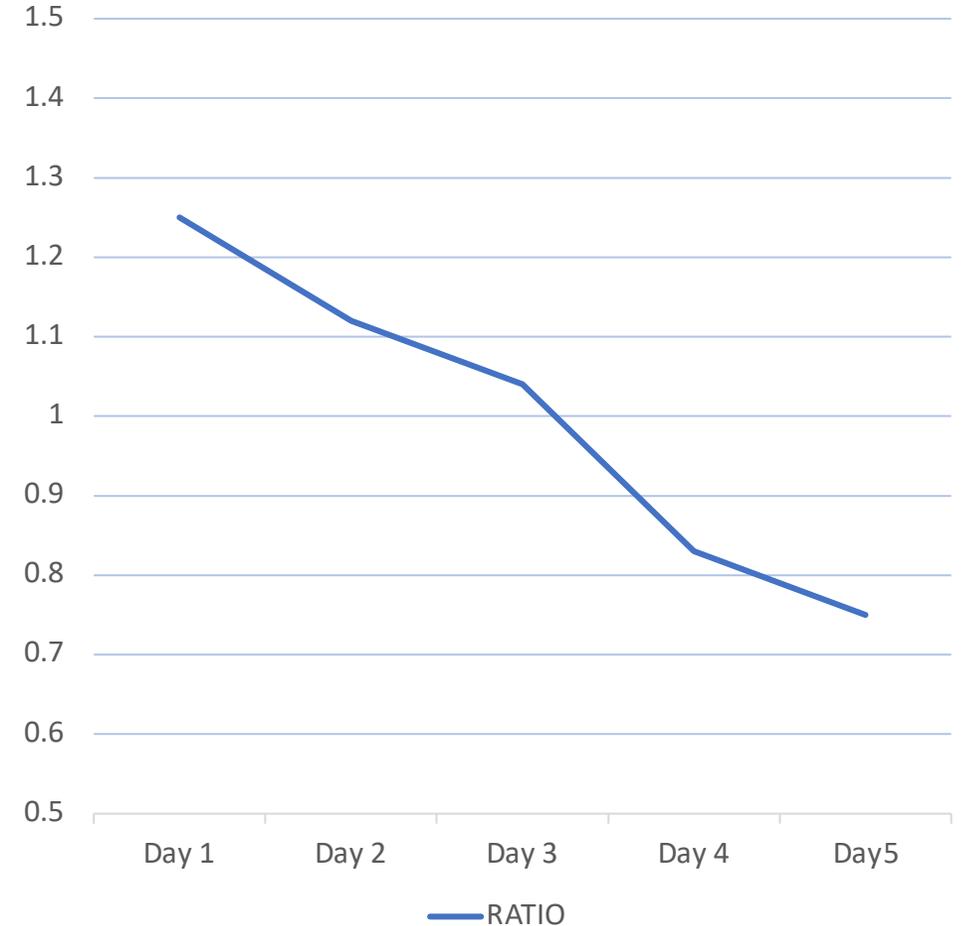
	Day 1	Day 2	Day3	Day 4	Day 5
Implied Volatility	15.00%	17.00%	21.00%	23.00%	25.00%
Historical 30-day Volatility	20.00%	20.25%	20.125%	20.50%	20.00%
Ratio	.75	.83	1.04	1.12	1.25



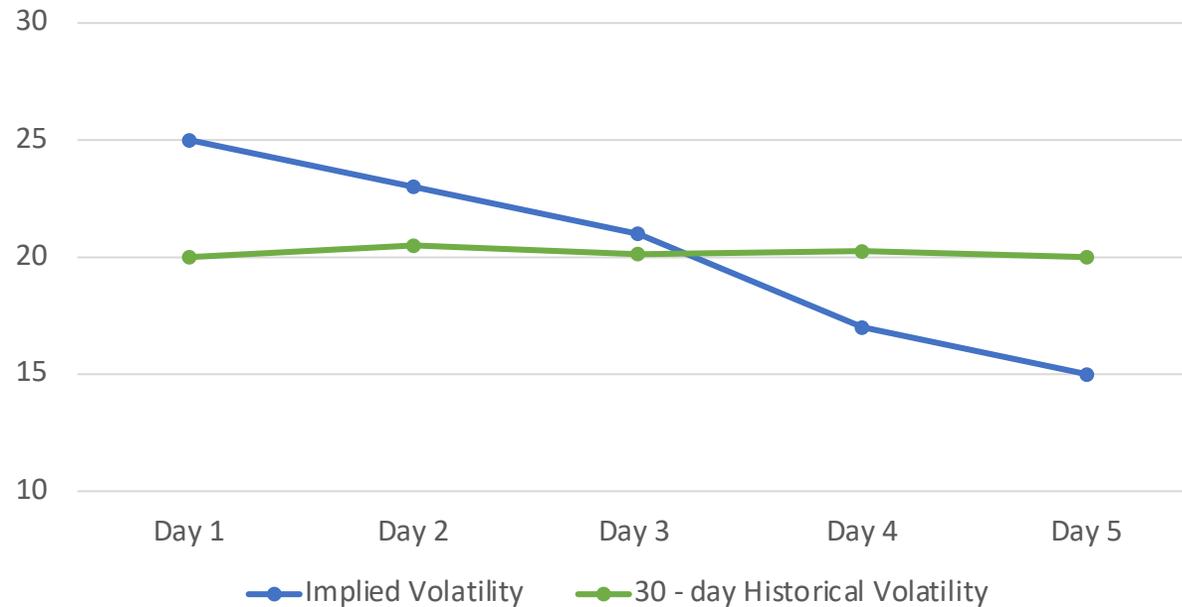
How the Ratio Can Move DOWN – Implied Volatility DOWN

	Day 1	Day 2	Day3	Day 4	Day 5
Implied Volatility	25.00%	23.00%	21.00%	17.00%	15.00%
Historical 30-day Volatility	20.00%	20.50%	20.125%	20.25%	20.00%
Ratio	1.25	1.12	1.04	.83	.75

Implied / Historical Vol Ratio

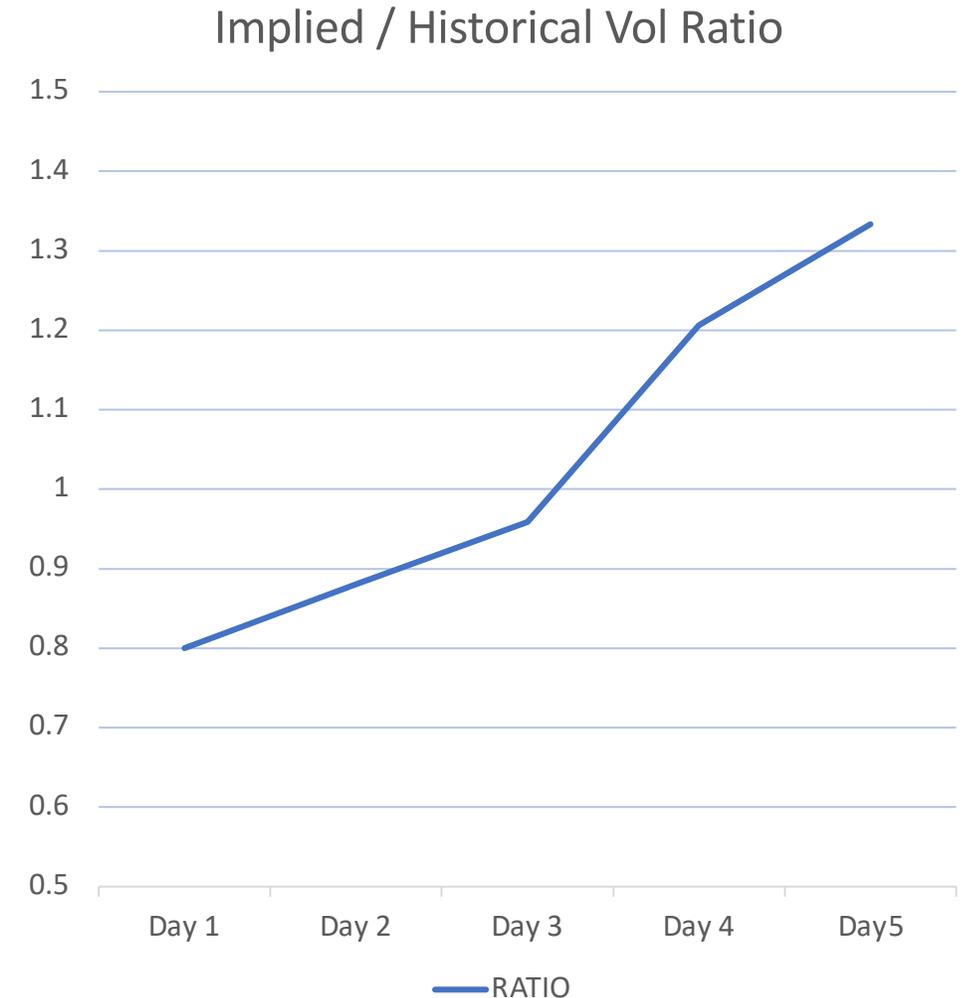
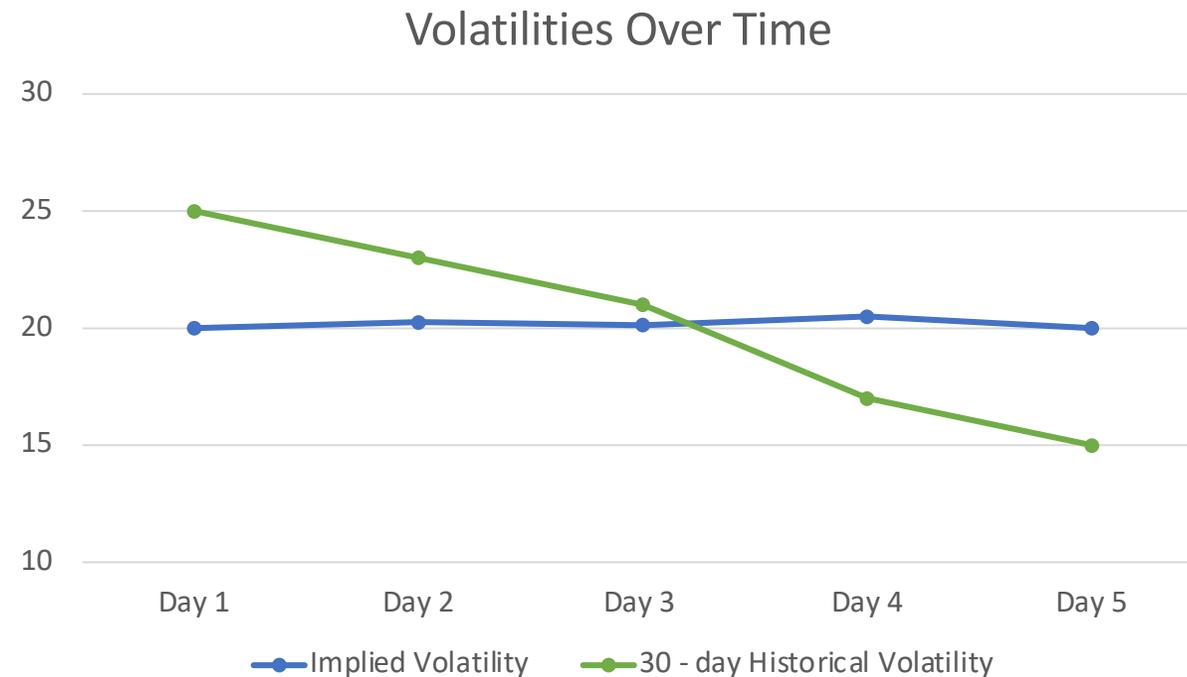


Volatilities Over Time



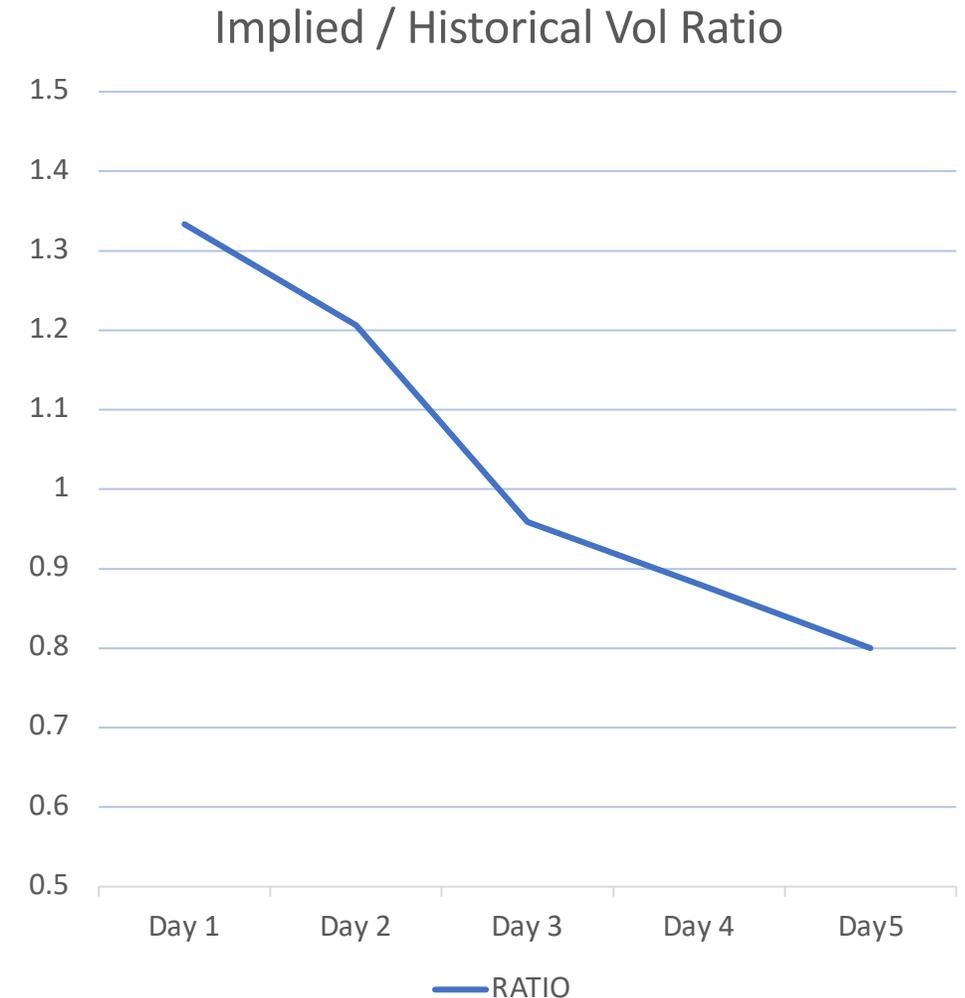
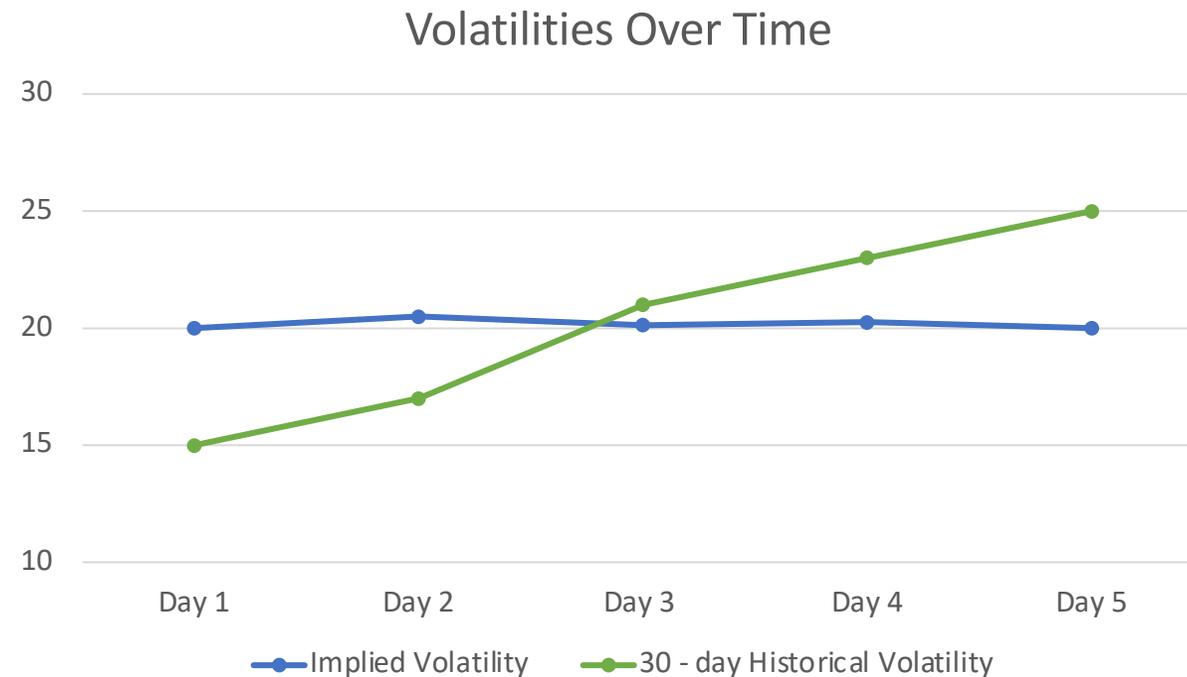
How the Ratio Can Move UP– Historical Volatility DOWN

	Day 1	Day 2	Day3	Day 4	Day 5
Implied Volatility	20.00%	20.25%	20.125%	20.50%	20.00%
Historical 30-day Volatility	25.00%	23.00%	21.00%	17.00%	15.00%
Ratio	.80	.88	.95	1.20	1.33



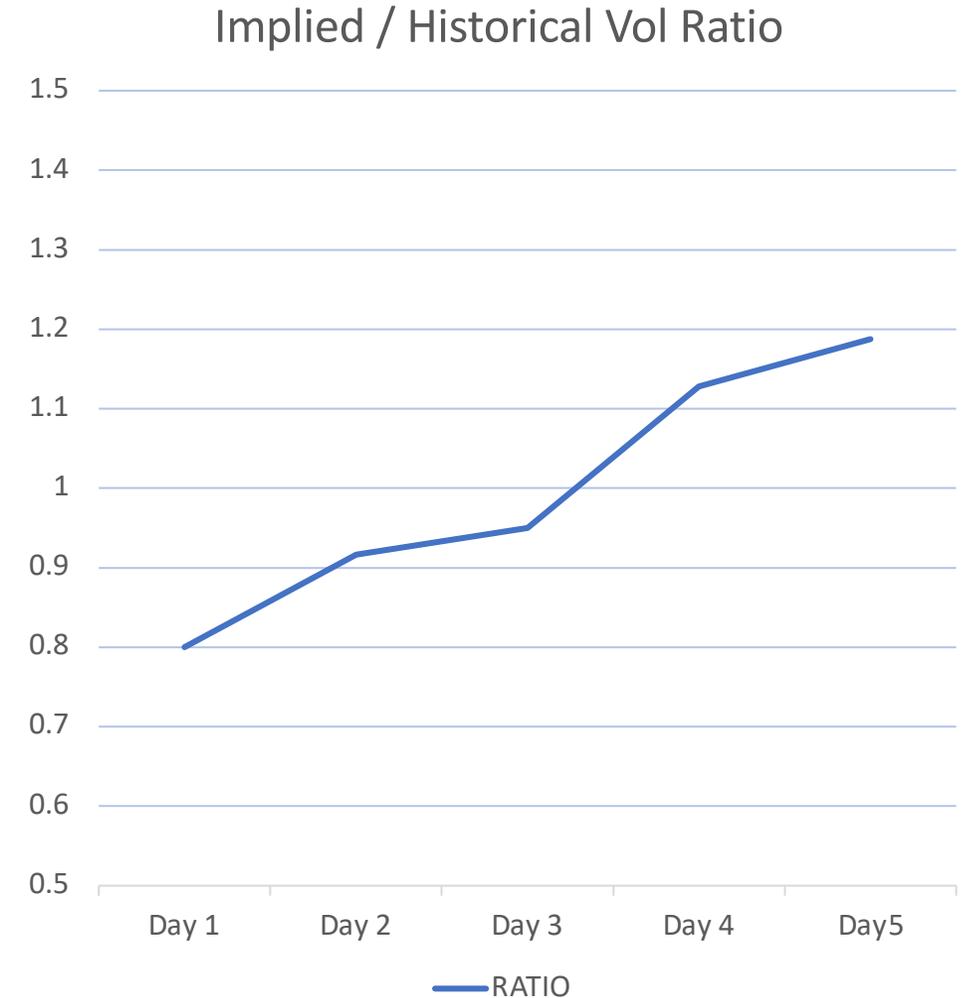
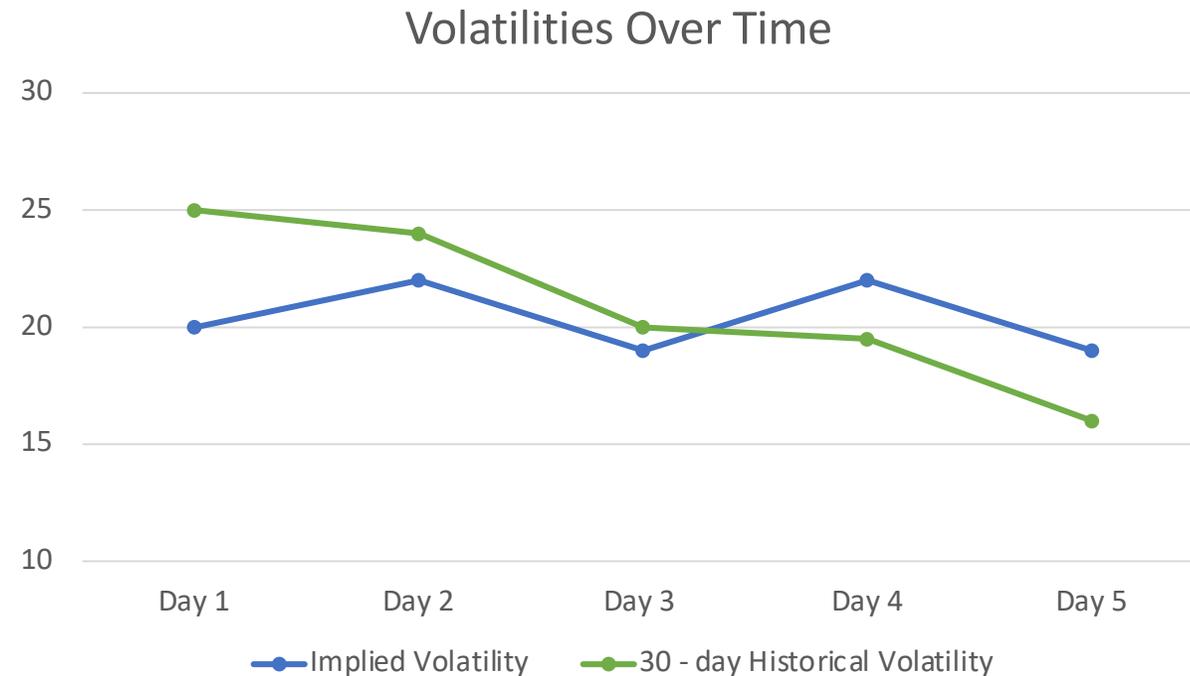
How the Ratio Can Move DOWN – Historical Volatility UP

	Day 1	Day 2	Day3	Day 4	Day 5
Implied Volatility	20.00%	20.50%	20.125%	20.25%	20.00%
Historical 30-day Volatility	15.00%	17.00%	21.00%	23.00%	25.00%
Ratio	1.33	1.20	.95	.88	.80



How the Ratio Can Move UP– Both Vols Moving

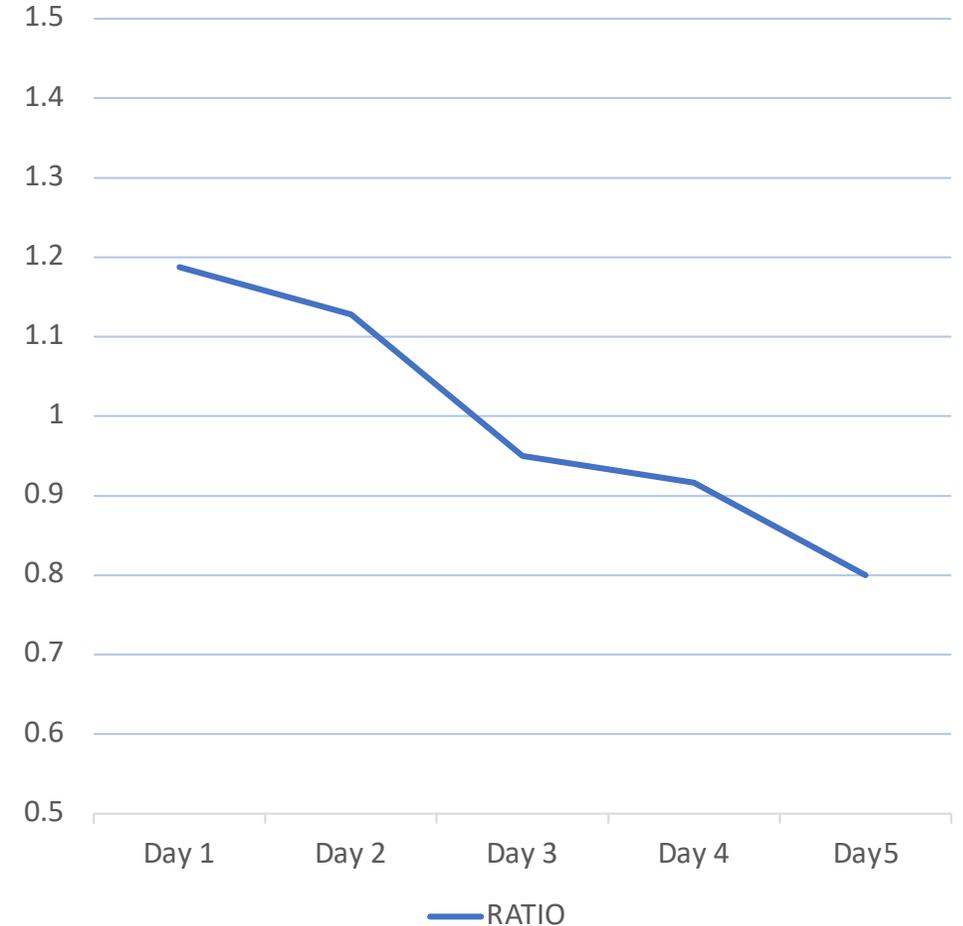
	Day 1	Day 2	Day3	Day 4	Day 5
Implied Volatility	20.00%	22.00%	19.00%	22.00%	19.00%
Historical 30-day Volatility	25.00%	24.00%	20.00%	19.5%	16.00%
Ratio	.80	.91	.95	1.12	1.19



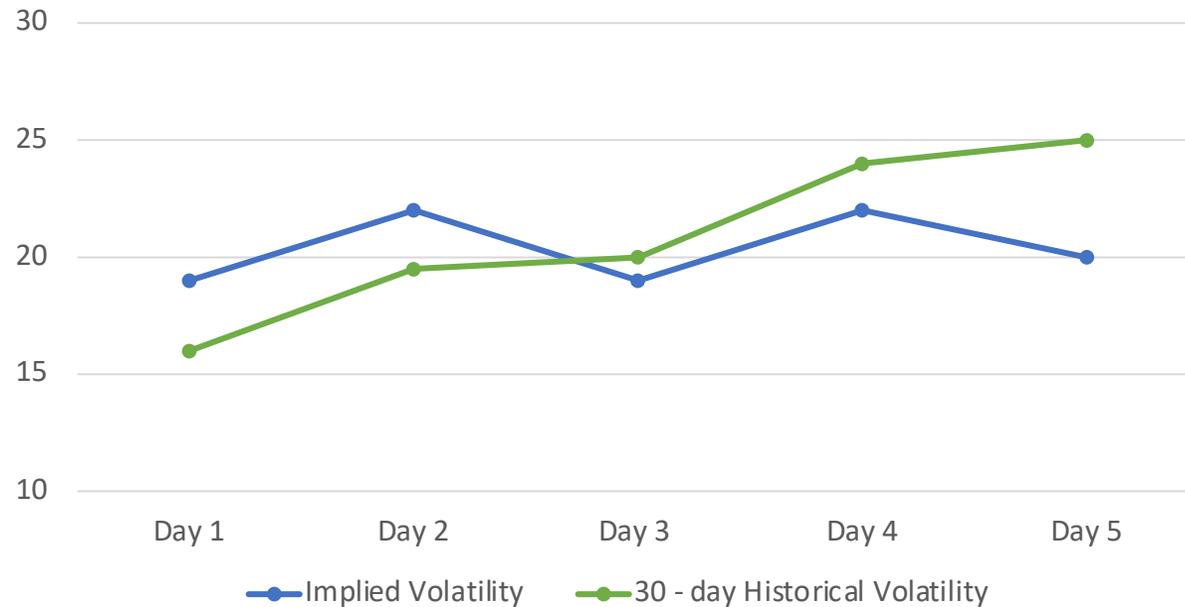
How the Ratio Can Move DOWN– Both Vols Moving

	Day 1	Day 2	Day3	Day 4	Day 5
Implied Volatility	19.00%	22.00%	19.00%	22.00%	20.00%
Historical 30-day Volatility	16.00%	19.50%	20.00%	24.00%	25.00%
Ratio	1.19	1.13	.95	.92	.80

Implied / Historical Vol Ratio



Volatilities Over Time



Putting the Framework into Practice



How things might line up – Two Assets

STOCK # 1

DTE: 30

Underlying \$40.00

Implied Vol: 70%

Price of 40 Straddle: \$6.40

Relevant Greeks: .11 Theta .10 Gamma

30 Day Delivered Vol: 60

Implied / Delivered Ratio : 70% / 60% = **1.17**



STOCK # 2

DTE: 30

Underlying \$55.00

Implied Vol: 50%

Price of 40 Straddle: \$6.25

Relevant Greeks: .11 Theta .10 Gamma

30 Day Delivered Vol: 55

Implied / Delivered Ratio : 50% / 55% = **.91**



If an investor sold a straddle in Stock #1 and bought a straddle in Stock #2, the greeks could look very neutral, your premium would be relatively neutral, and the investor would be considered SHORT the ratio of the two Implied Volatilities on a 1.40 Ratio. Stock #1 70% Implied Vol () Stock #2 50% Implied Vol.

70 % / 50 % = 1.40 Implied Ratio

How things might MOVE - Volatilities DOWN

STOCK # 1

DTE: 30

Underlying \$40.00

Implied Vol: 70%

Price of 40 Straddle: \$6.40

Relevant Greeks: .11 Theta .10 Gamma

30 Day Historical Delivered Vol: 60

Implied / Historical Ratio : 70% / 60% = **1.17**



STOCK # 1

DTE: 30

Underlying \$40.00

Implied Vol: 55%

Price of 40 Straddle: \$5.02

Relevant Greeks: .08 Theta .12 Gamma

30 Day Historical Delivered Vol: 60

Implied / Historical Ratio : 55% / 60% = **.92**

STOCK # 2

DTE: 30

Underlying \$55.00

Implied Vol: 50%

Price of 55 Straddle: \$6.25

Relevant Greeks: .11 Theta .10 Gamma

30 Day Historical Delivered Vol: 55

Implied / Historical Ratio : 50% / 55% = **.91**



STOCK # 2

DTE: 30

Underlying \$55.00

Implied Vol: 45%

Price of 55 Straddle: \$5.65

Relevant Greeks: .09 Theta .11 Gamma

30 Day Historical Delivered Vol: 55

Implied / Historical Ratio : 45% / 55% = **.81**

70 % / 50 % = 1.40 Implied Ratio

55 % / 45 % = 1.10 Implied Ratio

What the Implied Volatility Ratio Move Might Mean for Straddle Prices

Ratio	1.40 (70%/50%)	1.10 (55%/45%)	Net From Position
Stock #1 Straddle (Short position)	\$6.40	\$5.02	+\$1.38
Stock #2 Straddle (Long position)	\$6.25	\$5.65	-\$0.60
			+\$0.78

In this case, with both volatilities moving lower and repricing the Implied Volatility Ratio from 1.40 to 1.10, the investor could have a theoretically unrealized net gain of \$.78 from this Relative Value spread, while still maintaining a relatively Gamma neutral and premium neutral position between the two option positions.

How things might MOVE - Volatilities UP

STOCK # 1

DTE: 30

Underlying \$40.00

Implied Vol: 70%

Price of 40 Straddle: \$6.40

Relevant Greeks: .11 of Theta .10 Gamma

30 Day Historical Delivered Vol: 60

Implied / Historical Ratio : 70% / 60% = **1.17**



STOCK # 1

DTE: 30

Underlying \$40.00

Implied Vol: 90%

Price of 40 Straddle: \$8.20

Relevant Greeks: .13 of Theta .08 Gamma

30 Day Historical Delivered Vol: 75

Implied / Historical Ratio : 90% / 75% = **1.20**

STOCK # 2

DTE: 30

Underlying \$55.00

Implied Vol: 50%

Price of 55 Straddle: \$6.25

Relevant Greeks: .11 of Theta .10 Gamma

30 Day Historical Delivered Vol: 55

Implied / Historical Ratio : 50% / 55% = **.91**



STOCK # 2

DTE: 30

Underlying \$55.00

Implied Vol: 60%

Price of 55 Straddle: \$7.51

Relevant Greeks: .13 of Theta .08 Gamma

30 Day Historical Delivered Vol: 60

Implied / Historical Ratio : 60% / 60% = **1.00**

70 % / 50 % = 1.40 Implied Ratio

90 % / 60 % = 1.50 Implied Ratio

What the Implied Volatility Ratio Move Might Mean for Straddle Prices

Ratio	1.40 (70%/50%)	1.50 (90%/60%)	Net From Position
Stock #1 Straddle (Short position)	\$6.40	\$8.20	-\$1.80
Stock #2 Straddle (Long position)	\$6.25	\$7.51	+\$1.26
			-\$0.54

In this case, with both Volatilities moving substantially higher and repricing the Implied Volatility Ratio from 1.40 to 1.50, the investor could have a theoretically unrealized loss of -\$0.54 from this Relative Value spread, while still maintaining a relatively Gamma neutral and premium neutral position between the two option positions.

Key Points to Remember

- Historical Volatility and Implied Volatility are expressed in a similar way, but one is a backward looking metric and the other is a forward looking forecast.
- Relative Value is the Framework to evaluate an Asset - it's price or it's Implied Volatility in terms of another asset or another Implied Volatility.
- Implied / Historical Volatility ratio metrics can be used as a reference of how things have been moving over time, and how the options are pricing that forecasted movement in the future.

Key Points to Remember

- The power of expressing these levels as a Ratio is in the reductive quality of the function. Using this tool can help eliminate some absolute value bias, and allow for a more open frame of reference.
- Correlation of the assets is a key point to consider when making decisions as to what assets or underlyings you might include in your framework.
- Because of the nature of the Relative Value Ratio as a mathematical function, there can be multiple explanations for directional movement of the Metric.
 - A move **UP** in the Ratio does not always indicate a move up in the Numerator (Implied Volatility) and a move **DOWN** does not always indicate the opposite.
 - Often times this requires some analysis to be able to pinpoint from where and why the ratio is moving.

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