Quantcha US Equity Risk Metrics (QRM)

Portfolio managers are always looking for ways to measure and manage their risk. This database offers several invaluable metrics that can be used independently or in tandem to quantify and address risk. This database only covers optionable US equities.

Terms

Each of the types of metrics are provided for 30, 60, 90, and 360 calendar day terms. For an example illustrating how these terms are calculated, please see the VOL methodology.

Betas

Betas provide a measure of how sensitive the stock has historically behaved relative to overall market movement. This is also known as systematic risk. The betas provided here are generated for each equity against the SPY ETF, which is used as a proxy for the S&P 500 index. For example, a stock with a Beta30 of 0.50 has returned approximately 50% of the daily return of SPY over the past 30 calendar days (calculated as 21 trading days). Betas are unbounded and can range from very low negative numbers, such as -3 for a triple inverse S&P ETFs, to very high positive numbers, such as 3 for triple leveraged S&P ETFs. A beta of 1 has consistently matched the market's moves in both direction and magnitude.

Using Beta

There are many ways to apply beta that are useful to investors employing portfolio strategies at any level of sophistication.

Projecting Systematic Percentage Moves

Betas provide a leverage multiplier for a stock relative to the market. This means that it's easy to project the expected move of a stock given a theoretical move in the market.

For example, consider theoretical stock STOCK with a beta of 0.80. If SPY were to increase 1%, it can be modeled that—under ordinary conditions—the STOCK should increase by:

1% x 0.80 = 0.80%

Projecting Systematic Dollar Moves

Beta calculations are designed for modeling percentage changes. To perform dollar-based calculations, the *price ratio* of the stock price to the benchmark price needs to be used. Calculating the dollar-level sensitivity can be done by multiplying the price ratio by the beta.

For example, if STOCK were trading at $200 while SPY was trading at $400, the price ratio would be:

$200 / $400 = 0.50

The next step would be applying the beta such that:

0.50 x 0.80 = $0.40

This means that for every dollar SPY moves, STOCK should move $0.40.

Beta-Weighted Option Delta

The delta of a given stock or option measures how sensitive that position is to price movement in the underlying instrument. For example, a call option with a delta of $50 would be worth around $50 more if the underlying were worth $1 more and all other factors remained unchanged.

Multiplying this delta value by the underlying's beta by the price ratio produces its beta-weighted delta. This represents how sensitive the value of that position is to overall market at the dollar level.

Extending the example scenario from above, the beta-weighted delta for the delta 50 call referenced above would be:

$50 x 0.80 x 0.50 = $20

This means that a move of $1 in SPY would be expected to increase the value of the option by $20.

While these measurements are approximations based on a very complex system of equations used to derive option value, they do provide a mathematically sound baseline for reasonable analysis. At the same time, it's necessary to acknowledge that the underlying mathematics are continuous and every change produces subtle changes in all relevant products. As a result, the Greeks should be recalculated often.

Beta-Weighted Book and Portfolio Delta

A *book* is the collection of share and option positions for a single underlying while a *portfolio* is the collection of all books. To calculate the *beta-weighted delta* for a given book, simply add up all of the beta-weighted deltas for each constituent position.

Alternatively, beta-weighted delta can be calculated by adding up all the net delta for the book and multiplying it by the underlying's beta and price ratio.

Either way, this represents the expected change in the value of the book for a $1 movement in SPY.

To calculate beta-weighted delta for the entire portfolio, add the beta-weighted deltas of each book. This provides an approximation of how the entire portfolio should change with a $1 move in the market.

Book Leverage

The *leverage* of each book can be calculated by multiplying the net delta (not beta-weighted delta) by the price of the underlying and then dividing by its total *risk basis*. Risk basis is the greater of the book's liquidation value less margin loans and margin requirement.

For example, consider a book consisting only of a long call position on STOCK with a delta of $50 trading at $2.50/share ($250/contract). Since there is no margin requirement, the liquidation value of $250 is used as the risk basis. The leverage for this book—relative to investing purely in STOCK shares—is:

$50 x $200 / $250 = 40

Another way to think of this is that if you instead spent that $250 on shares, you would only get 1.25 shares, which is 1/40 of the 50 delta the option position provides.

Leverage should be calculated for the entire book using the net risk basis to account for margin requirements related to covered short positions, naked positions, and so on.

Book Weight

The portfolio's risk basis is the aggregate sum of each book's risk basis. Each book's *weight* is its risk basis proportion.

For example, consider the STOCK book to have a risk basis of $250. If the overall portfolio has a combined risk basis of $1000, then the STOCK book's weight is:

$250 / $1000 = 25%

Portfolio Beta

Portfolio beta measures the multiple by which a portfolio should perform relative to the market. Just like with individual stocks, a beta of 1 indicates that the portfolio should match the performance of the market, etc.

A common strategy for portfolio managers is to select a diverse portfolio of positions such that they achieve a portfolio beta of 1. This means that their portfolio should not deviate significantly from the performance of the market overall. However, if their chosen long and/or short positions outperform as hoped in aggregate, their portfolio will edge out the market whether or not the net change is positive or negative.

Another strategy is to target a portfolio beta of 0. This type of portfolio is expected to provide consistent gains that perform without any apparent relationship to the performance of the market itself. By removing systematic risk, the portfolio can be expected to deliver its results regardless of how the overall market performs.

Calculating Portfolio Beta

The *portfolio beta* is the sum of each book's *beta contribution*. The beta contribution of each book is its leverage multiplied by its beta multiplied by its weight.

For example, if the STOCK beta is 0.80 and its book has a leverage of 40 with a weight of 25%, its beta contribution to the portfolio is:

0.80 x 40 x 25% = 8

The process would be repeated to calculate the beta contribution of the remaining 75% of the portfolio and added to this value to produce the portfolio beta.

Correlations

Correlations provide a measure of how consistently a stock has historically behaved relative to overall market movement. The correlations provided here are generated for each equity against the SPY ETF. For example, a stock with a Spy30 of 0.50 has usually moved in the same direction as the daily return of SPY over the past 30 calendar days (calculated as 21 trading days). Correlations are bounded from -1 (inversely correlated) to 1 (positively correlated). A correlation at or near 0 indicates that there has not been a relationship between the movement of the stock and the movement of SPY.

Using Correlations

Correlations are parameters commonly used by statistics processes. The specific application of correlations will vary from scenario to scenario. Beta is a better fit for most processes that require simple math to produce a measure of performance relative to the market.

Relationship of Betas and Correlations

While betas and correlations are similar in nature, they tell different sides of the story. For example, a stock may have a high beta and a low correlation, which indicates that the stock has strong reactions to market moves, but that it's also significantly impacted by factors independent of the market. On the other hand, a low beta with a high correlation could indicate that the stock moves with the market, but is not as volatile.

Systematic and Unsystematic Risk

Like beta, the systematic and unsystematic risk measurements can be used to help manage risk at a book and portfolio level. Whereas beta is a coefficient that applies to price movement, these risk

measurements provide insight as to how much of an underlying's implied volatility are due to systematic factors (IV of SPY) vs. independent IV due to the unique circumstances of the stock itself.

Systematic Risk Coefficient

To calculate the systematic risk coefficient, divide the systematic risk into the sum of systematic and unsystematic risks.

For example, if the systematic risk is 0.24 and the unsystematic risk is 0.08, then the systematic risk coefficient is:

0.24 / (0.24 + 0.08) = 0.75

Systematic Vega

To calculate the systematic vega for an option position or book, multiply its net vega by the systematic risk coefficient.

For example, if a book had a net vega of $80 and its underlying systematic risk coefficient of 0.75, its systematic vega can be calculated as:

$80 x 0.75 = $60

Portfolio Systematic Vega

A portfolio's systematic vega is the aggregate sum of the systematic vegas of each book. A value of 0 means that the portfolio is fully hedged against change in market volatility as measured by SPY. However, like all Greeks, this is a continuous measurement that may change regularly and require re-hedging as factors change.

Quantcha Risk Worksheet

Please see the Quantcha Risk Worksheet (Excel) for an example of how a portfolio can be measured and tracked for each of these metrics.

Quantcha Risk Worksheet

https://data.nasdaq.com/QRM

Quantcha
https://quantcha.com

Portfolio	
Delta (Beta)	$ (76.60)
Gamma (Beta)	$ (24.36)
Vega (Systematic)	$ (37.62)
Basis	$36,918.00
Beta	-0.9411

Market	
SPY	$ 453.58

Key
Variables To Edit
Calculated
Labels

Book	Shares	Price	Beta	Systematic Risk	Unsystematic Risk	Risk Basis	Net Delta	BW Delta	Net Gamma	BW Gamma	Net Vega	Vega (Systematic)	Vega (Unsystematic)	Leverage	Weight	Weighted Beta
MSFT	100	$ 355.08	1.34	21%	6%	$34,418.00	$ 47.61	$ 49.94	$ (1.51)	$ (1.58)	$ (23.41)	$ (18.21)	$ (5.20)	0.49	93.23%	0.6136
AAPL	0	$ 195.10	1.29	20%	4%	$ 2,500.00	$ (228.05)	$ (126.54)	$ (41.05)	$ (22.78)	$ (23.30)	$ (19.42)	$ (3.88)	-17.80	6.77%	-1.5547

Option	Underlying	Contracts	Delta	Gamma	Vega	Net Delta	Delta (Beta)	Net Gamma	Gamma (Beta)	Net Vega	Vega (Systematic)	Vega (Unsystematic)
355 Call 9 DTE	MSFT	-1	0.5239	0.0151	0.2341	$ (52.39)	$ (54.96)	$ (1.51)	$ (1.58)	$ (23.41)	$ (18.21)	$ (5.20)
195 Call 2 DTE	AAPL	-5	0.5264	0.1241	0.0704	$ (263.20)	$ (146.04)	$ (62.05)	$ (34.43)	$ (35.20)	$ (29.33)	$ (5.87)
200 Call 2 DTE	AAPL	5	0.0703	0.042	0.0238	$ 35.15	$ 19.50	$ 21.00	$ 11.65	$ 11.90	$ 9.92	$ 1.98

Data Details

This database covers over 9,000 optionable US equities with history to 2006. There are over 5,000 optionable stocks currently trading. Data is updated by 5:30PM ET on market days.

Data Dictionary

Field	Description	Other terms
Beta30	The 30-day beta against SPY.	60, 90, 360
Cor30	The 30-day correlation with SPY.	60, 90, 360
Srisk30	The 30-day systematic risk relative to SPY.	60, 90, 360

Urisk30	The 30-day unsystematic risk relative to SPY.	60, 90, 360