Investment Planning Answer Book by Jay L. Shein, Risk Adjusted Measures of Return

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Financial advisors are always looking for a statistic or process to evaluate and pick the correct investments. Advisors that are looking to evaluate money managers, separate accounts, or mutual funds use a variety of methods to make the decision. The decision process cannot be strictly quantitative but has to include significant amounts of qualitative information. Risk adjusted measures of performance are valuable tools typically used by advisors; however, they should not be used in isolation since, like any statistic, they have limitations. These measures of risk adjusted performance are used to see if the investment strategy or manager adds value. Financial advisors and investors should not rely on any measurement of performance or risk adjusted performance to indicate that their portfolio is safe just because these statistical measures suggest that this is so.

Investment Planning Answer Book by Jay L. Shein, Q 6:1, What is the Sharpe ratio?

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The Sharpe ratio is a measure of risk adjusted performance. The formula is as follows:

$$S_p = \frac{\overline{r_p} + \overline{r_f}}{\sigma_p}$$

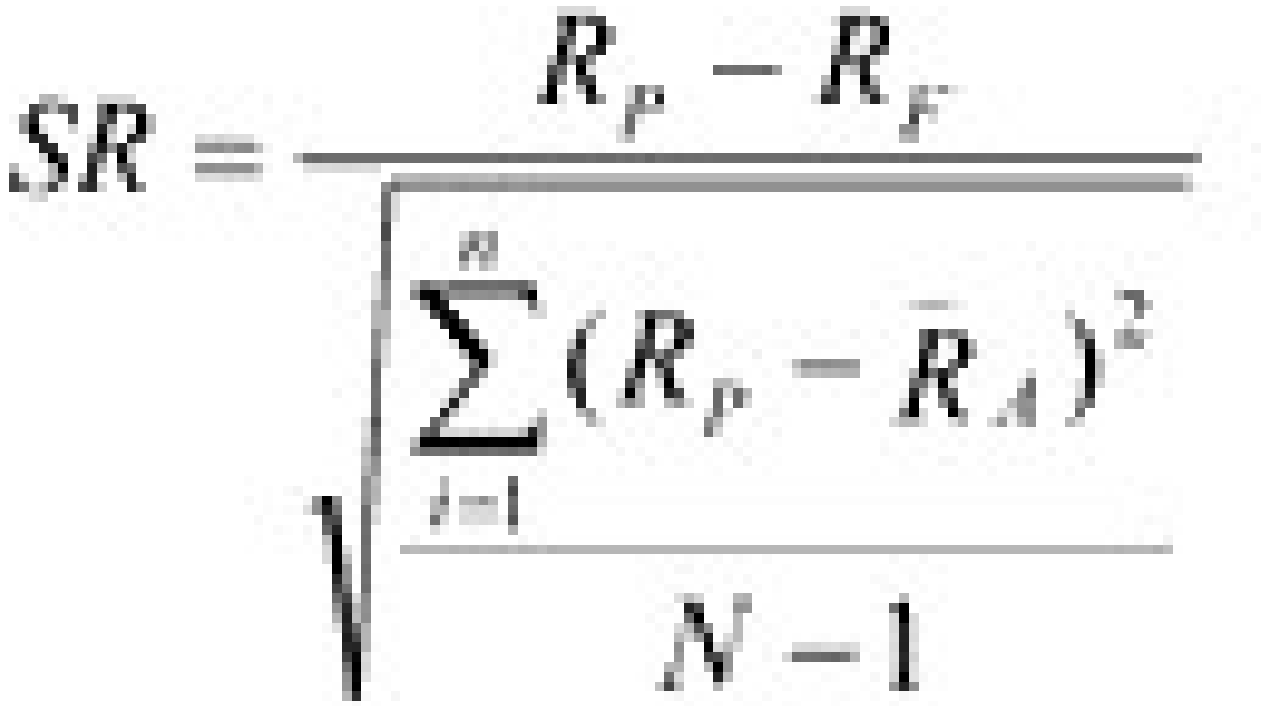
Where:

r_p = the return of the portfolio

r_f = the risk-free rate

σ_p = the standard deviation of the portfolio

This Sharpe ratio formula is not adjusted for a degree of freedom. Most money manager software analysis programs adjust for a degree of freedom. In that case, the formula would be as follows:



Where:

SR = Sharpe ratio

R_p= manager or fund return

R_F= risk-free rate

R_A= manager or fund arithmetic mean return

N=number of return periods

The Sharpe ratio is easy to calculate and is also supplied by many database vendors. The Sharpe ratio gives the risk premium per unit of total risk. This ratio gives the added return above the risk-free rate for each unit of risk. The added return above the risk-free rate is also referred to as the risk premium. The Sharpe ratio takes the magnitude of the mean into account. The Sharpe ratio is a method of scaling returns which allows for the comparison of various managers or portfolios. It is important when comparing investment portfolios to determine which one adds more value when adjusted for risk. The investment manager with a higher Sharpe ratio indicates a better risk adjusted return. The Sharpe ratio is also referred to as the reward to variability ratio, excess return Sharpe ratio, or the Sharpe performance index.

Investment Planning Answer Book by Jay L. Shein, Q 6:2, Why not use return and standard deviation instead of the Sharpe ratio to compare investment portfolios?

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Looking at an example of two portfolios, portfolio A and portfolio B:

	Standard Deviation	*Mean*	*Risk-Free Rate*	*Sharpe Ratio*
Manager A	14%	28%	3%	1.79
Manager B	9%	9%	3%	0.67

When looking at manager A and manager B, it appears that manager B has the lowest risk as measured by standard deviation. However, because the means are different, the portfolio return needs to be scaled. When using the Sharpe ratio, we find that manager B is actually riskier than manager A. It can be concluded from this example that manager A has a higher return for each unit of risk than manager B.

Another example of portfolio X and portfolio Y is as follows:

	Standard Deviation	*Mean*	*Risk-Free Rate*	*Sharpe Ratio*
Manager X	14%	9%	3%	0.43
Manager Y	33%	16%	3%	0.39

In this example, manager X has a better return per unit of risk. The portfolio with the higher Sharpe ratio is usually the best choice as it gives you the highest return per unit of risk. If the means were the same, standard deviation and return could be used to determine the best risk-adjusted performance. In most cases, the means will be different, and therefore, the Sharpe ratio will give the better measure of risk-adjusted return. If you are adding an investment manager to an existing portfolio, the Sharpe ratios will not tell you how that addition will affect the overall portfolio since it will not take into account the correlation coefficient of that manager with the rest of that portfolio.

Investment Planning Answer Book by Jay L. Shein, Q 6:3, Are there any drawbacks to using the Sharpe ratio?

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The Sharpe ratio is best used in fairly liquid, diversified portfolios that have normal distributions. Investment portfolios such as hedge funds, which may not have normal distributions, may exhibit skewness and kurtosis in their return distributions. Skewness and kurtosis interfere with the ability of the Sharpe ratio to measure risk adjusted performance. Some might argue that standard deviation is not the proper measure of risk. Investors looking at historical Sharpe ratios use standard deviation returns from previous periods. While historical Sharpe ratios may give a good indication of the general trend, this past performance does not guarantee or indicate the future. Sharpe ratios that are forward looking (ex-ante) use projections of return and risk that are limited by the uncertainty of the future.

Investment Planning Answer Book by Jay L. Shein, Q 6:4, What is the difference between the information ratio and the Sharpe ratio?

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The information ratio, like the Sharpe ratio, is a measurement of risk adjusted performance. Information ratio looks at the residual return relative to the residual risk. The Sharpe ratio is a measure of excess return over the risk-free rate divided by the standard deviation of the portfolio. The information ratio is the excess return over the benchmark divided by the standard deviation of the excess return. The Sharpe ratio is sometimes referred to as the excess return ratio, and the information ratio is sometimes referred to as the selection return ratio.

Investment Planning Answer Book by Jay L. Shein, Q 6:5, What are the components of the information ratio?

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The information ratio is made up of residual return or excess return over the benchmark divided by the residual risk or the standard deviation of excess return. The residual risk is typically referred to as the tracking error which is the denominator in the information ratio. Sometimes, residual return is referred to as alpha. To understand the information ratio, the calculation of tracking error is important. The calculation of tracking error when adjusted for one degree of freedom is as follows:

$$TE = \sqrt{\frac{\sum_{j=1}^{n} (R_P - R_B)^2}{N - 1}}$$

Where:

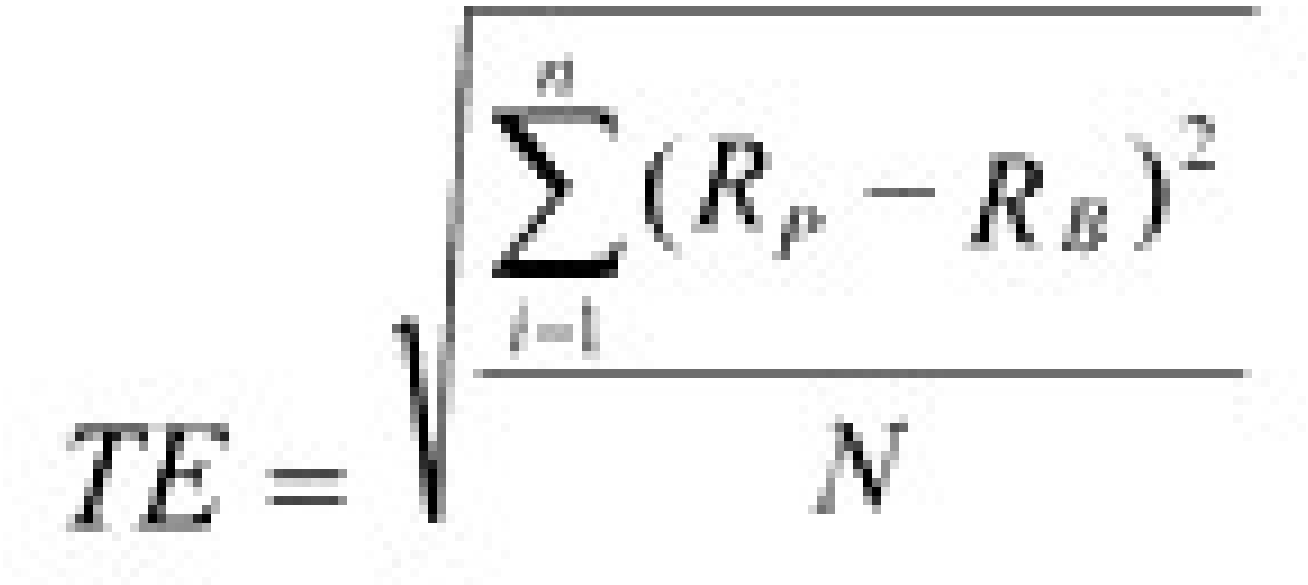
TE = tracking error

R_P = return of manager or fund

R_B = return of benchmark

N = number of return periods

If not adjusted for one degree of freedom, tracking error is calculated as follows:



Where:

TE = tracking error

R_P = return of manager or fund

R_B = return of benchmark(s)

N = number of return periods

Most software vendors' default calculation adjusts for one degree of freedom. Some vendors allow you to calculate tracking error using either method.

The investment manager, portfolio, or mutual fund with the higher tracking error may indicate that the manager is making more style bets, security selection decisions, and/or has transaction costs and fees. If an advisor is looking for an investment that has a positive alpha or added value, then they will have to have a tracking error above zero. However, just because an investment has a tracking error above zero does not mean that the alpha or added value will be positive. The benchmark used for the tracking error and the information ratio can be a passive benchmark or a returns based style benchmark.

The numerator in the information ratio is the return of the portfolio minus the return of the benchmark. The information ratio gives an indication that the manager is making frequent, consistent, and successful decisions. The information ratio when adjusted for one degree of freedom is calculated as follows:

$$IR = \frac{R_P - R_B}{\sqrt{\frac{\sum_{i=1}^{n} (R_P - R_B)^2}{N - 1}}}$$

Where:

IR = information ratio

R_P = manager or fund return

R_B = return of benchmark

N = number of return periods

If not adjusted for one degree of freedom, information ratio calculated as follows:

$$IR = \frac{R_P - R_B}{\sigma_A}$$

Where:

IR = information ratio

R_P = return of manager or fund

R_B = return of benchmark(s)

σ_A= standard deviation of the active return

The one difference between the Sharpe ratio and the selection Sharpe ratio is the benchmark. The Sharpe ratio uses risk-free assets such as treasury bills, and the selection Sharpe ratio, known as the information ratio, uses a passive index or returns based style benchmark.

Investment Planning Answer Book by Jay L. Shein, Q 6:6, Does the information ratio help in investment manager selection?

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The information ratio, considered a risk adjusted measure of performance, is focused on the residual return which is defined as the active return that comes from the manager's decisions relative to that residual risk (active risk). It is used to compare the skill between managers. The manager with the highest information ratio is considered to have the highest risk adjusted measure of performance. How well the investment manager takes advantage of the various opportunities that are available is reflected in this statistic. A manager that makes style, sector, and/or security selection bets successfully will have the highest information ratio. The information ratio for the benchmark will always be zero. The information ratio can be used to see how well a manager did in the past (e.g., their ex-post skill) or how well they are expected to do in the future (e.g., the ex-ante assessment of their skill). While many advisors will choose the investment portfolio with the highest information ratio, this conclusion may add additional risk that does not meet with portfolio objectives. Risk should be taken into account. The tracking error or residual risk is part of the assessment as it is the denominator in the fraction that represents the information ratio. Consider the following example using two managers, manager X and manager Y:

	Excess Return	*Tracking Error*	*Information Ratio*
Manager X	1.12%	1.3%	0.86
Manager Y	3.4%	3.6%	0.94

Looking at the information ratio, the best choice would be manager Y. But manager Y had a larger tracking error to produce the excess return. For investors who are risk averse, this is an important consideration. The investment manager may be able to vary the tracking error to be able to maintain the information ratio on an ex-ante basis.

Information ratio does help to determine if a portfolio has a high probability of consistently out-performing its benchmark. If a manager is able to out-perform their appropriate best benchmark over time, it would indicate investment skill. Investment managers who can demonstrate that they have skill will have higher information ratios. Like other measures of risk adjusted return, the information ratio should be used to compare similar managers or portfolios.

Investment Planning Answer Book by Jay L. Shein, Q 6:7, How can a spreadsheet be used to calculate the information ratio?

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To calculate the information ratio in a spreadsheet, use the following method: list the historical returns on either a monthly or quarterly basis in column A. List the appropriate benchmark returns in column B. Column C would be the manager returns minus the benchmark returns (e.g. column A minus column B). Then use the statistical functions in the spreadsheet software to compute the various parts of the information ratio.

Column A: Manager's Monthly Returns	***Column B: Benchmark's Monthly Returns***	***Column C: Column A − Column B***
−2.06	−2.43	0.37
−0.72	−0.46	−0.26
0.28	1.86	−1.58
8.19	7.39	0.8
6.95	4.99	1.96
1.3	1.38	−0.08
2.19	2.49	−0.3
4.23	2.49	1.74
−2.72	−1.07	−1.65
6.28	5.62	0.66
1.55	1.05	0.5
3.95	3.46	0.49
2.66	2.04	0.62
1.83	0.64	1.19
−1.02	−1.85	0.83
−1.5	−1.16	−0.34
1.24	1.86	−0.62
1.31	1.25	0.06
−4.03	−5.65	1.62
−0.77	−0.49	−0.28
2.55	0.95	1.6
2	1.56	0.44
4.24	3.44	0.8
3.07	3.92	−0.85
−2.46	−3.33	0.87
2.15	1.06	1.09
−1.44	−1.82	0.38
−2.54	−1.9	−0.64
4.6	4.84	−0.24
1.58	−0.37	1.95
4.95	4.89	0.06
1.03	−1.29	2.32
0.89	0.46	0.43
−1.79	−0.97	−0.82
4.64	4.31	0.33
2.21	−0.31	2.52

The calculation then becomes the average of Column C (0.4436) divided by the standard deviation of Column C (0.9964). The information ratio is calculated as follows:

Information ratio = 0.4436 / 0.9964 = 0.4452

Investment Planning Answer Book by Jay L. Shein, Q 6:8, What is a Sortino ratio?

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The results of measures that are based on downside risk will be similar to the results of measures used in standard deviation if the return distribution is normal. One of the shortcomings of standard deviation is that it treats upside performance the same as downside performance. Because standard deviation does not differentiate between upside and downside risk, a manager, fund, or portfolio that produces high returns can have the same standard deviation as those that have low returns. Since most investors are concerned with the downside risk, which is poor performance, measures of downside risk seem to have intuitive appeal. The Sortino ratio is one of those measures and is calculated as follows:

$$\text{Sortino} = \frac{\bar{r}_p - \bar{r}_f}{\sqrt{sv}}$$

Where:

r_p = the return of the portfolio

r_f = the risk-free rate

sv = semivariance

Downside deviation, which is the square root of the semivariance, uses the same methodology as calculating standard deviation except that it only looks at returns that fall below a mean or target. When looking at a target semivariance, use only returns that fall below a benchmark or an investor's minimally acceptable return (MAR).

Investment Planning Answer Book by Jay L. Shein, Q 6:9, Are there any criticisms of downside measures of risk?

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It can be argued that standard deviation, which is a measure of total risk, gives a better picture of the risk an investment is exposed to. An investment with a string of high returns would have a high standard deviation and a low downside deviation. While this might look like a low risk investment as measured by downside deviation, it might indicate more likely lower returns in the future. From 1980 to 1989, the Japanese stock market had positive returns in every year even though the returns varied on a yearly basis. In 1990, it had a large negative return. Downside deviation would have indicated low risk while standard deviation would have picked up the higher risk and would have been a more appropriate measure. The Sortino ratio, which uses downside deviation in its denominator, has the same limitations as any measure of downside risk. Measures of downside risk have come to be known as Post Modern Portfolio Theory (PMPT). The Sortino ratio is part of this body of knowledge. The Sortino ratio will typically rank investment portfolios or managers the same. However, the magnitude of the difference between the rankings is greater with the Sortino ratio than other measures of risk such as the Sharpe ratio. The Sharpe ratio may rank two managers the same, indicating that they have the same excess return per unit of risk while the Sortino ratio may show a different picture. Consider the following portfolios:

Measure	*Portfolio X*	*Portfolio Y*	*Best Portfolio*
Return	16%	13%	X
Standard deviation	8%	7%	Y
Sharpe ratio	1.5%	1.5%	equivalent
Downside risk	1.8%	14%	X
Sortino ratio	3.7%	0.5%	X

The higher the Sortino ratio is, the better the measure of risk adjusted return based on downside risk. When the Sortino ratio gives a different ranking of portfolios or managers than other risk adjusted measures of return, the advisor needs to investigate and ascertain the correct reason for the discrepancy. A possible reason for these differences may be due to a difference in the shape of the distribution of returns such as those that may be found in portfolios that contain hedge funds, options, or other derivative strategies.

Investment Planning Answer Book by Jay L. Shein, Q 6:10, What are the different benchmarks used in calculating the Sortino ratio?

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The Sortino ratio is the same as the Sharpe ratio except for the denominator in the fraction. Different methods are in use to calculate the denominator. One method is to use only returns that fall below the mean in calculating the downside deviation. Another is to use a minimally accepted return (MAR) for a particular investor.

EXAMPLE 6-1

If the investor's MAR was 7%, only returns that fell below that would be considered in the calculation for downside deviation. One of the better methods would be to use a Sharpe returns based style analysis for the benchmark and only look at returns that fell below that benchmark when calculating the downside deviation.

Investment Planning Answer Book by Jay L. Shein, Q 6:11, What is alpha?

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Alpha is a risk adjusted measure of performance that measures value added above a benchmark or the expected return based on the Capital Asset Pricing Model (CAPM). The Jensen alpha is calculated by subtracting the CAPM return from the actual portfolio return. For example, an investment portfolio has a return of 9 percent, and the CAPM return is 7 percent. Therefore, the investor's portfolio has an alpha of 2 percent. If the investor's return had been 6%, the portfolio would have had a negative alpha of -1 percent. The Jensen alpha formula is as follows:

$$\alpha_p = \overline{r}_p - \left[\overline{r}_f + \left(\overline{r}_m - \overline{r}_f\right)\beta_p\right]$$

Where:

α_p = Jensen alpha

r_p = portfolio return

r_f = risk-free rate

r_m = return of the market

β_p = investment portfolio beta

Alphas are best used when comparing similar portfolios. The alpha of an all stock portfolio should not be used to compare to an alpha of a balanced portfolio which contains a mixture of stocks and bonds. If the betas of portfolios are fairly close, then a comparison of the alphas is more reliable.

This discussion of the Jensen alpha describes the most common measurement of alpha used in finance theory. Many in the investment community refer to alpha as the excess return over the benchmark they have chosen.

Investment Planning Answer Book by Jay L. Shein, Q 6:12, How does the Capital Asset Pricing Model (CAPM) work?

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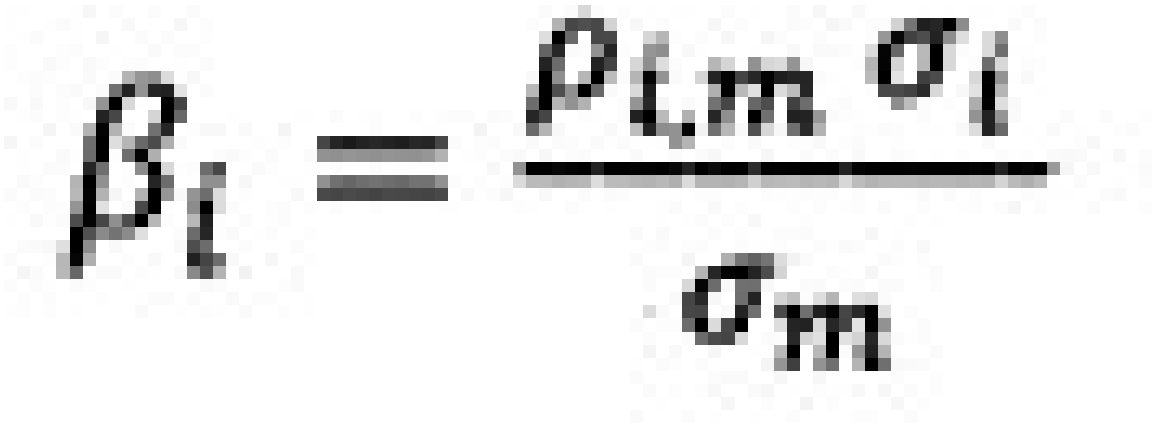
The CAPM is a measure of risk adjusted return. It is a measure of an investment's sensitivity to a benchmark. That sensitivity is known as beta. Beta is calculated by the following formula:



Where:

β_i = beta

$\beta\rho_{i,m}$ = correlation between the investment and the market

σ_i = standard deviation of the investment

σ_m = standard deviation of the market

Beta measures systematic risk. A beta greater than one is indicative of higher systematic risk than the market, while a beta of less than one indicates less systematic risk than the market as a whole. A low beta may indicate an investment strategy that includes derivatives or has an element of market timing. Some critics of beta feel that it may not be a good measure of risk relative to return because the securities are not always related directly

to their beta. If beta has no value, then the CAPM could not be used. Most investment advisors would not be willing to disregard the use of beta. Beta can be easily used to measure the risk of a portfolio after a particular investment is added to that portfolio. The beta of the portfolio is simply the weighted average of the betas of the individual investments, money managers, and mutual funds.

EXAMPLE

Investment	*Amount Invested*	*Beta*	*Weighted Beta*
A	$500,000	0.8	0.2
B	$500,000	1.2	0.3
C	$1,000,000	0.6	0.3
		Portfolio Weighted Beta	0.8

The equation for the Capital Asset Pricing Model is as follows:

Where:

r_i = return on the investment

r_f = risk-free rate

r_m = return on the market

β_i = beta of the investment

The CAPM is a financial model which indicates what return would be required given the investment's risk (beta). The rate of return one expects on an investment can be compared to the rate of return implied by the CAPM. In this manner, the advisor can determine whether the investment is undervalued or overvalued. CAPM uses beta, which is a standardized measure of systematic risk. Some academics have suggested that beta is dead and is not a good measure of risk as security returns are not always related to their beta. Most investment advisors would be best served by still considering beta without relying on it as their only measure of risk. The betas are generally not stable for individual stocks, but they are stable for a portfolio of stocks. The more stocks in the portfolio and the longer the period of time being measured, the more stable the beta of the portfolio.

Beta is considered a single factor model while other models use multiple factors to explain the risk and return of investments such as price-to-earnings ratio and book-to-market ratio. Even with all the criticism of measures of risk adjusted return that include beta and CAPM, these measures can be very valuable, especially in measuring risk when markets are declining.