AGILE GROUP

Risk as measured by the Greenberg-Silverstein Risk Assessment

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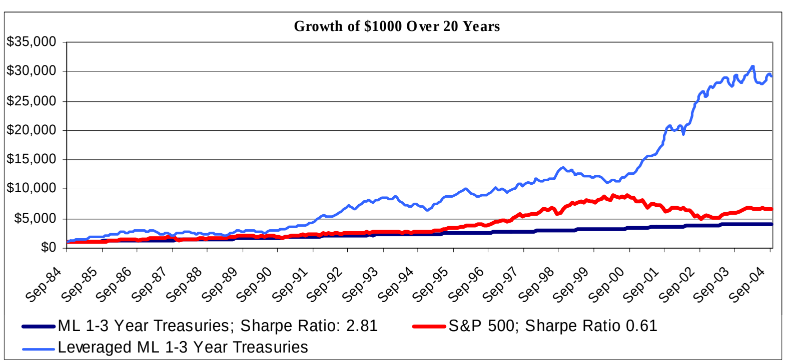
How to Measure Risk

It is nearly impossible to formulate a way to effectively measure the risks of different investment vehicles. A top investment analyst once said, "Anyone who can properly measure risk is likely to be a billionaire". That may in fact be true. The traditional measures of risk are quickly evolving, and we as an investment firm felt that we needed to have highly sophisticated tools that would help us to assess quantitative risks. Below we describe how our quantitative evaluation of investments has evolved through time, and the single risk measure we ultimately developed to incorporate various aspects of quantitative risk. The risk measures described below cannot effectively measure liquidity[1], operational or fraud risk. Having said that, our investment process places a high level of importance on qualitative risk assessment and due diligence procedures**.**

Return/Risk Ratios

We believe that it is important to assess both quantitative and qualitative risks in all investment decisions. In our analyses we have found that it is essential to be able to assess an investment's RETURN in LIGHT of risk. We needed a way of looking at risk adjusted returns and felt that the traditional return/risk ratios were deficient. As we will discuss, there are a variety of ratios that can be used which divide return by a simplistic and often misleading measure of risk. As you will see, the simplicity of looking at a ratio is very compelling.

You can always obtain a higher return by allocating more assets to riskier strategies or investments; however, a better portfolio can be created by looking for superior returns per unit of risk that is taken. For example, let's say an investor wishes to take a risk level of 15%[3]. This can be accomplished by investing in an index tracking the S&P 500, however, leveraging up a less risky portfolio of short term bonds to the same risk level will have a far better performance. Looking at a return/risk ratio, in this case the Sharpe Ratio, tells us that the better and more efficient asset has not been stocks, but has been short term bonds. Hence, one's returns would have been much higher through the levered short term bond investment over the past 20 years, with the same level of variation, versus an investment in the S&P 500 index.



[1] It might be possible to assess the "liquidity risk" through the use of the Herfindahl Index or the Ljung-Box test by evaluating the extent of the "auto-correlation" of returns.

Armenc, N., Malaise, P., Martellini, L., Matthieu, V. 2004. Discussion Paper: Fund of Hedge Fund Reporting - A Return Based Approach to Fund of Hedge Fund Reporting. pp 32. http://www.edhec-risk.com/edhec_publications [October 2004].

[3] We are referring to the "annualized standard deviation" as risk at this point, though as you will see later, we do not think this is the best measure of risk.

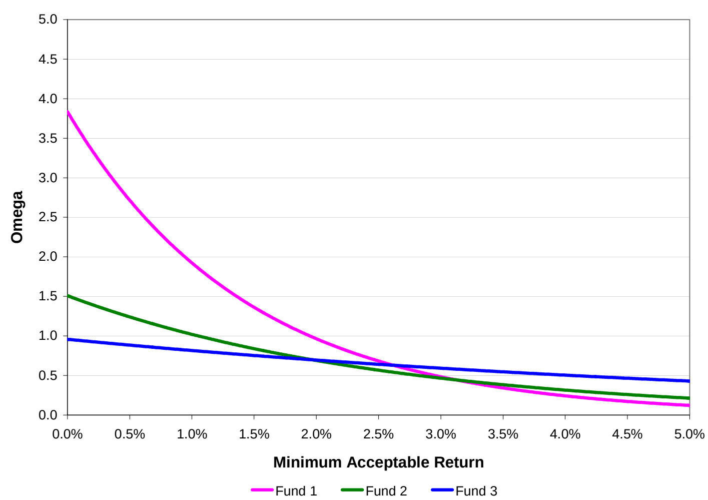
We believe that measuring return/risk can help us identify which investments are giving us the most performance per unit of risk. This methodology paired with qualitative due diligence helps us to determine the optimal allocation of our investments. In this case, risk means our view of risk. The rest of this article deals with traditional methods of risk assessment and how we view and then measure risk. Hence, if we determine that the qualitative risks are identifiable and minimal, then we need a method to compare different investments quantitatively within that context as one of many tools to inform our allocation decision.

Standard Deviation: Outdated

The investment community takes for granted the use of certain commonly used risk measures, notably Standard Deviation[4]. In fact, if you look carefully at what comprises a common sense view of risk, it is likely that Standard Deviation isn't a good proxy of risk for a wide variety of reasons. For example, normal distributions generally don't exist in the investment world, but are implied in the Standard Deviation calculation. Also, highly variable, but positively skewed returns may not be as risky as their Standard Deviation may imply. Based upon this rationale, other measures are needed to effectively measure the risk of an investment. The Sharpe Ratio is quite famous as a means of measuring risk adjusted returns by creating a ratio of excess return[5] divided by risk. The inherent limitation with using the Sharpe Ratio to measure risk is that it suffers from using Standard Deviation as the measure for risk.

Omega and Omega-Sharpe Ratio

Omega is compelling because it measures risk without assuming a normal distribution. It takes into consideration the third and fourth moment of distribution, skewness and kurtosis. An inherent limitation to Omega is that it is highly sensitive to a minimum acceptable return number that must be chosen as you can see in the chart below. Sharpe Omega is an extension that uses Omega rather than Standard Deviation in the Sharpe Ratio calculation for the denominator (risk).



[4] This refers to the standard deviation of a historical return stream. Typically, an annualized standard deviation is used and can be derived, typically, from monthly data, or from other time units such as daily or weekly.

[5] Excess return means the return that is in excess of a risk free return that could have been theoretically derived, from, say, t-bills or other similar instruments.

Downside Deviation and Sortino Ratio

Downside deviation or semi-deviation which is standard deviation below the minimum acceptable return is very intriguing When Professor Markowitz, the founder of modern portfolio theory, originally discussed using standard deviation he suggested that using semi-deviation to measure risk would be preferable; however, in his day it was more time consuming to calculate. Hence, he suggested using standard deviation instead. Standard Deviation is more popular than Semi-deviation despite the fact that Markowitz himself would certainly have preferred the latter as a measure of risk. It is a better measure but still does not resolve issues associated with non-normal distributions. This risk measure is used in calculating the Sortino Ratio, another means of measuring risk adjusted returns by creating a risk/return ratio (like the Sharpe or Omega Sharpe). In the Sortino Ratio, the excess returns are divided by the standard deviation of the returns below an acceptable minimum return.

Value at Risk or VAR

Other risk measures try to look at the maximum expected loss during a particular time frame, typically within a confidence level. Value at Risk or VAR is used for this measure.

Advanced VAR

Unfortunately, VAR only deals with the worse case within a confidence level. Taking that further is B- VAR or Beyond VAR, which deals with the average loss once you have exceeded the confidence interval. Finally the Cornish Fisher VAR modifies the standard VAR based on the skewness and kurtosis, the third and fourth moments of distribution.

Drawdown and Calmar Ratio

Similarly, historical Drawdown measures the decline from a prior high, and is a very interesting way of measuring risk. Maximum Drawdown is the largest drawdown that an investment has experienced. It represents the denominator in Calmar Ratio, which is another method for measuring risk adjusted return. Maximum Drawdown might not reflect a true worse case scenario, since we don't know if the past will prove to be indicative of the future. Also, only looking at the maximum drawdown may be misleading because funds with shorter track records are inherently more likely to have a smaller maximum drawdown and looking at only the worst drawdown does not distinguish between a fund with one drawdown and a fund with many drawdowns.

Compelling-Ulcer Index

We find it compelling to consider Drawdown in some form because it is a natural expression of risk and is probably the most easily understood proxy for risk. Additionally drawdowns have a time component. The amount of time that an investment is in a drawdown from a prior high also contains valuable information. Steven Shellans invented something that he calls an Ulcer Index to combine time under water with the depth of drawdown, similar to measuring the "area" of a drawdown.

Our Original Approach

Until recently, we have been using two factors to measure drawdown. Over the course of our investing life, we created a drawdown persistency index consisting of the following factors:

1. TWO LARGEST DRAWDOWNS: Many of the investments that we have been interested in have suffered one or two significant losses during their history, as well as many smaller ones. Therefore, we incorporated the two largest

drawdowns, under the assumption that they generally represented much more significant events that told the bigger story about the investment's risk profile; however, this is not always true with specific types of investments that are prone to high volatility such as managed futures.

2. TIME UNDERWATER: We also used the percentage of time that an investment has been underwater as a second factor.
3. COMBINED FACTOR: We then combined these two factors, weighting the larger of the two drawdowns more significantly.

Success

Using this COMBINED FACTOR as a measure of risk, and then creating a risk adjusted return by dividing excess return by risk, we developed the Greenberg Drawdown Persistency Index. We believe we have had some success utilizing this index. Our hedge fund of funds, Agile Safety Fund, has extremely good risk/return characteristics based upon the investment objectives of our clients and our firm, as well as by the typical industry measure of a Sharpe Ratio (2.57 as of Sept. 30th 2004 using the 3 month T-bill as the risk free rate).

Our New Approach

As we felt that our old approach was incomplete in its evaluation of all of the risk factors associated with an investment, we created a four factor model. The first two factors consider extreme losses and the second two factors consider more of a quality aspect of risk, based on the historical return stream. In thinking about risk, there is an issue of "displacement"; that one might be getting rid of a strategy that still is working, but is having a bad spell due to cyclic factors rather than a permanent or long term displacement of the strategy.

Greenberg-Silverstein Risk Assessment (GSRA)

GSRA is named after its developers, Neal Greenberg and Sara Silverstein, two employees of Agile Group**.** GSRA consists of four factors:

1. **Time Weighted Cumulative Drawdown:** This factor measures the historical drawdown, giving a smaller measure for older drawdowns under the assumption that a manager learns his lessons on balance, hence older drawdowns are less indicative of risk, relative to more recent drawdowns. Discounting older drawdowns also helps to correct any potential age bias that could occur based upon differing time periods of return history, without discarding vital information. This measure considers both the magnitude of each drawdown, as well as the percentage of time the fund is in a drawdown.
2. **Conditional VAR (CVAR):** As explained above, the VAR calculation does not address the worst case scenario of a fund which is arguably one of the greatest risks to the investor. A very large drawdown that occurs infrequently can be problematic for two reasons. First, there will be a tendency for the investor to lose confidence and move out of the strategy; we call this **displacement risk**. Second, a large loss requires a large percentage gain to recover principal[6]. As an example, a loss of 50% requires a 100% gain on the remaining capital to break even. We have used a non-parametric calculation in order to estimate the expected loss, given that the fund's performance is below the VAR.

[6] Here is the formula for calculating the percentage return required to break even after a loss:
R=(1/(1-L))-1 where **R** is the **Recovery Return (**to break even), and **L** is the **Percentage Loss** .

3. **Modified Standard Deviation:** We have created a standard deviation that we modify downwards if "fat tails" are positive (we don't believe that extreme upwards events are bad; however, they affect the standard deviation in the same way that extreme downward events do). We modify it upwards if "fat tails" are negative. Likewise, a positively skewed distribution's standard deviation is modified downwards, while one that is negatively skewed is modified upwards.
4. **Rolling Return Scores:** This factor measures the percentage of rolling returns that are not positive. We assumed that rolling returns told us if a fund was risky as to "displacement". The six month score is most heavily weighted, based upon our own level of patience with a manager.

<u>Weighting the Factors</u>

The factors were weighted by analyzing how we intuitively look at risk and then running a regression analysis. Our portfolio management team ranked the risk of a variety of fund return streams without knowing their identity. These rankings were used to determine the weightings used in the final GSRA.

<u>Risk Adjusted Return</u>

Using the Fund's Return in excess of an implied risk free return and incorporating the GSRA into the denominator, we can compare different assets as to their Risk Adjusted Returns in a way similar to the Sharpe Ratio which divides excess return by Standard Deviation. We call this the Greenberg Ratio, named after the author.

<u>Significance Score</u>

Additionally, we created a significance score that tells us the significance of the information based upon the age of the fund. (It is expected that if daily historical performance numbers for an investment were used, one might be able to improve the significance of the GSRA in a shorter period of time).

<u>Conclusion</u>

The GSRA method of evaluating risk and return/risk will be an interesting and fresh start that emphasizes the more practical components of risk. We believe that our factors for measuring risk are more intuitive than the traditional measures being employed:

1. Drawdown, reduced by age.
2. Amount of time underwater
3. Worst case drawdowns
4. Frequency of long term non-performance and
5. Standard deviation modified by some kurtosis and skewness

The following pages present an in-depth discussion of the GSRA indicator.

Greenberg-Silverstein Risk Assessment

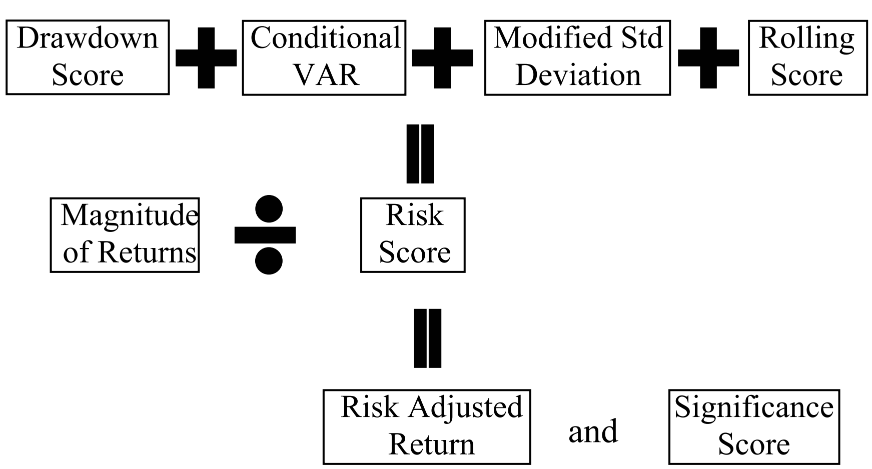
The goal of the GSRA is to evaluate funds on a risk-adjusted performance basis in a way that reflects the Agile Group's view of risk. The ratios and risk statistics that are currently available either have too little information or make false assumptions, such as normal distributions.

Initially each member of the investment team was given a group of sample hedge funds to evaluate. The team members assigned a risk score to each fund in the sample group that was independent of the magnitude of the fund's returns. All qualitative information was left out of the information that the team members received, so that they would be making their assessments of the funds based solely on the quantitative information available. In order to be in line with the actual investment process, all of the risk assessments were compiled and given to the CEO and CIO, Neal R. Greenberg, in order for him to determine the risk score that would be used for this process.

In order to create a system that would be able to evaluate thousands of funds, in a way that resembles how our investment team assesses risk, we had to figure out which quantitative factors have the most significant impact on the subjective risk scores and what the relationship was between these statistics and the subjective scores. The process that we followed involved statistically analyzing which statistics met this criterion, adjusting these statistics and fundamentally evaluating what factors made the most sense. These statistics were normalized, linearized and then regressed against the subjective scores created by the team. The regression analysis assigned a weighting to each of the factors for the final risk score.

The final risk score is intended to be skewed such that the quality funds will be scored between 1 and 70, even though they make up a small percentage of the total funds. This places the large group of unacceptable funds between 70 and 100, giving more granularity to the scores of the superior funds.

In the end the four factors that were used consisted of a time weighted cumulative drawdown factor, a conditional VAR factor, a rolling return factor and a modified standard deviation factor. These four factors make up the final Greenberg-Silverstein Risk Assessment which is inputted into the denominator of the Greenberg Ratio. A significance factor was also created in order to determine how reliable each risk score is.



Time Weighted Cumulative Drawdown

The drawdown score was designed to capture the severity, length and recency of every drawdown, as well as the amount of time a fund has spent underwater. The formula below looks at the depth of the drawdown for every month of the fund's history (if the fund is not underwater one month the depth is zero). The size of the depth is discounted based on how much time has passed since it occurred. This allows us to reflect that a 10% drawdown three months ago is worse than a 10% drawdown three years ago. These numbers are added together and then divided by the number of months of data that is being evaluated. This incorporates the percentage of months the fund has been underwater into the calculation, as only months that were underwater have a value other than zero.

Extended Data

Because a fund is penalized not only for the depth of their drawdowns but also for the length of their drawdowns, there is an inherent bias toward funds that are currently in the middle of a drawdown. We correct this bias by extending the fund's data using the fund's average monthly return for each month up to six months or until the fund is no longer under water. Because of the way the calculation works, this data is only considered if the fund is currently in a drawdown on the last available month of data and only proceeds for as long as the fund is still in the drawdown based on the extended returns.

$$X = \frac{\sum_{i=-5}^{n} (U_i * D_i)}{n}$$

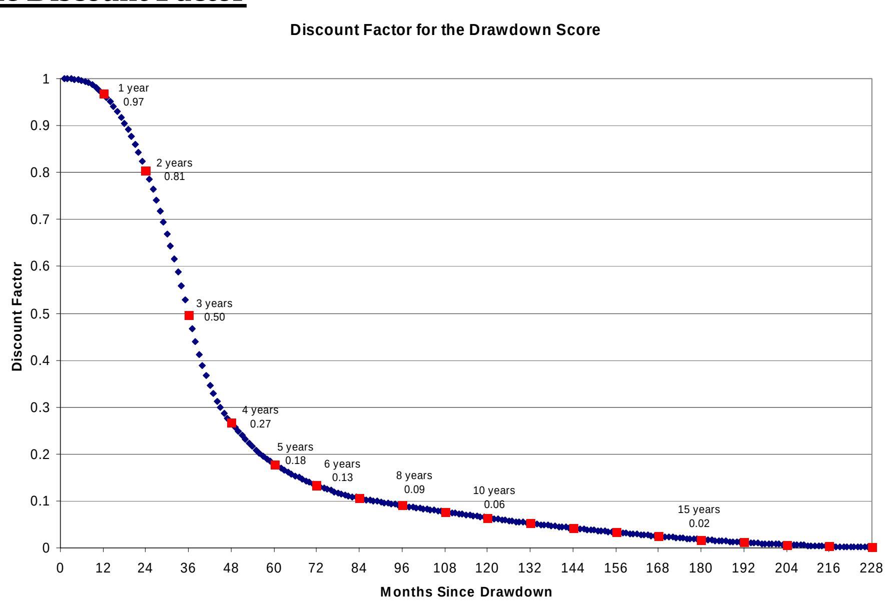
Where:

U_i is the depth of the drawdown at time i (i=1 for the first data point and i=n for the most recent data point)

D_i is the discount factor at time i

n is the number of data points

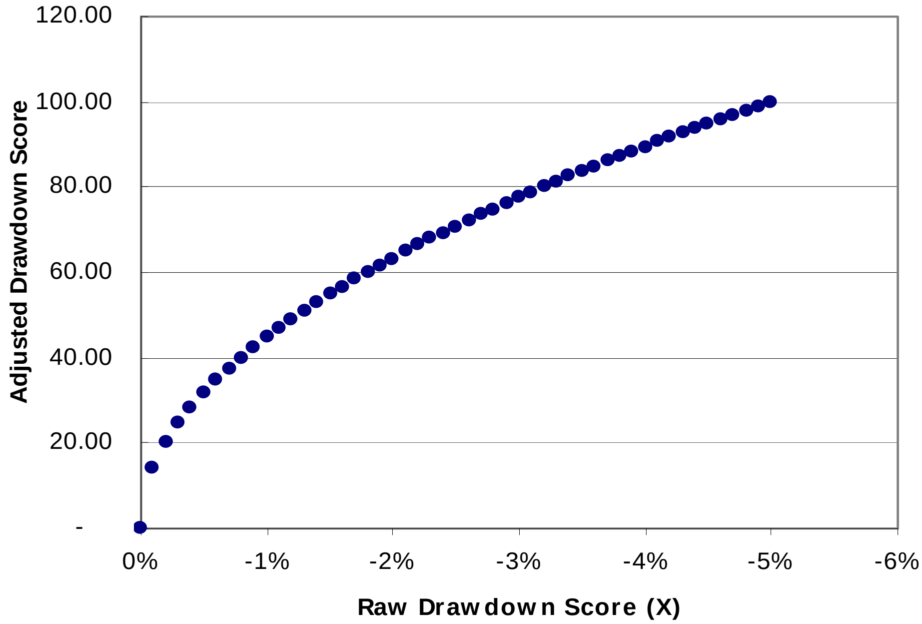
The Discount Factor



Transition Formula

Each of the four factors has a "transition formula" that transforms the score from its raw form into a number that can be used in the multiple linear regression analysis, with the subjective quantitative scores of the sample funds. This formula attempts to correct any non-linear relationship the raw score may have with our risk assessment. This transformation also gives more meaning to each factor by putting every score onto the same scale. Note that each factor must have a score from 0 to 100.

$F_1 = (-200000*X)^{1/2}$



Conditional VAR (Estimated Tail Loss)

The Value At Risk (VAR) is a common statistic used in evaluating hedge fund managers and portfolios. A VAR calculation with 95% confidence approximates the maximum loss the fund should experience 95% of the time. The Estimated Tail Loss estimates what the expected loss should be the 5% of the time that the VAR is exceeded. We use a non-parametric calculation because we cannot define the cumulative distribution function of a fund's return with any certainty.

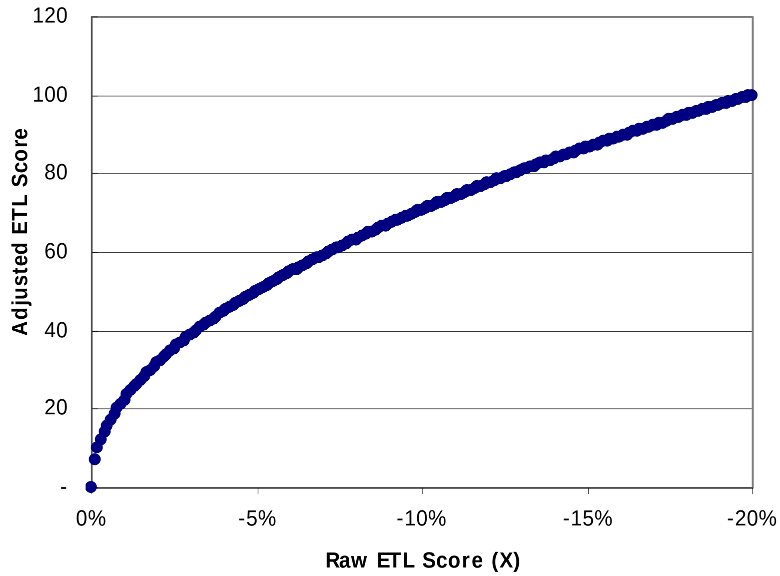
The following formula calculates the average loss that exceeds the non-parametric Value At Risk with 95% confidence. If the number of data points is insufficient to calculate an average, the worst monthly performance is used providing that it is less than zero.

$$X = \frac{\sum_{i=1}^{t} (R_i)}{t}$$

Where:
R_i is the monthly return such that (R_1 is the worst monthly return; R_2 is the second worst monthly return, etc.)
t is the number of data points R_i such that $i < (.05)*n$ and $R_i < 0$. (If $(.05)*n < 1$ then $t=1$ if $R_1 < 0$)

Transition Formula

$$F_2 = ((-500*X)^{1/2})*10$$



Rolling Return Score

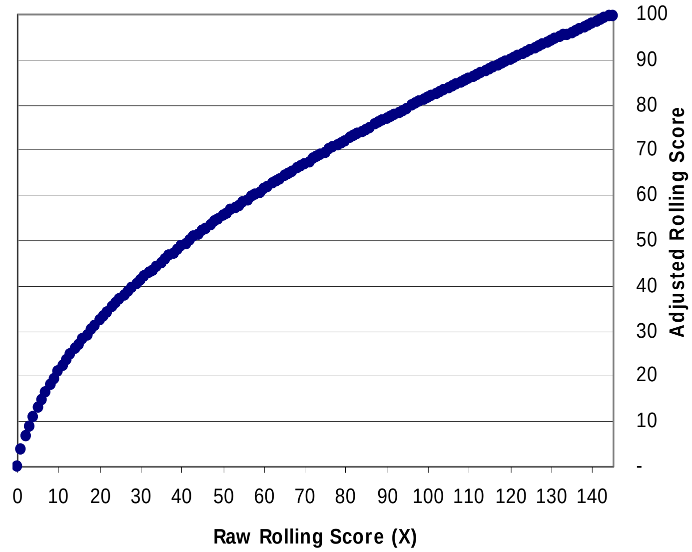
The fourth factor described later in this document attempts to describe the distribution of a fund's monthly returns; however, the rolling period factor is more concerned with the order in which the returns occur. We are cautious of funds that have very long rolling periods below zero, which is why the six month rolling period is weighted higher than the other time periods. The three month rolling period was added mainly to give granularity to the high number of funds that have never had a six month rolling period that returned less than zero, and the percent of negative months was used to decipher between the funds that had no three or six month periods that returned below zero.

$$X = P_1 + (10)*P_3 + (100)*P_6$$

Where:
P_1 is the percent of months that had a return above zero for that same month.
P_3 is the percent of 3 month rolling periods that had a return above zero for that same period.
P_6 is the percent of 6 month rolling periods that had a return above zero for that same period.

Transition Formula

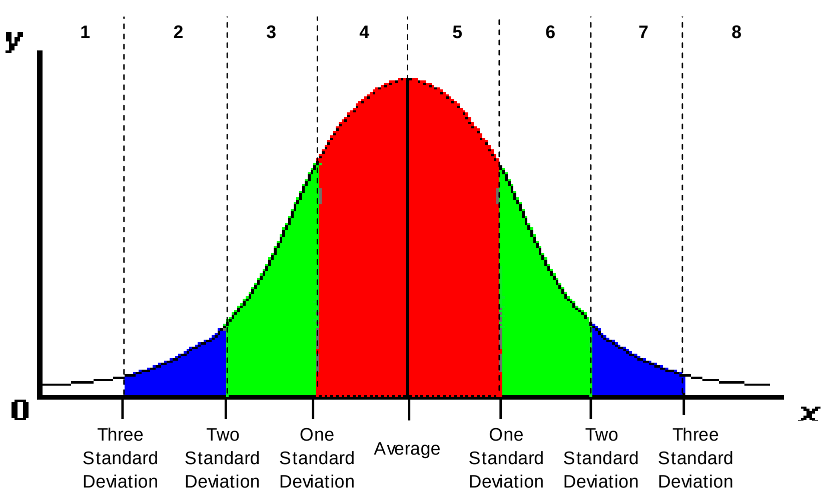
$F_3 = ((X+1)^{1/2})*9-9$



Non-Normal Modified Standard Deviation (Distribution Score)

Most statistics used to evaluate hedge fund risk assume a normal distribution, despite the fact that hedge fund returns typically do not fit into this mold. In order to determine what the variation of returns is without assuming a normal distribution, we are using an adjusted standard deviation which incorporates the non-normal characteristics of the distribution.

If a normal distribution curve is broken up into eight sections by standard deviation moves above and below the mean you can determine the probability of returns falling in each of these sections.



Probability of falling in a given section of the curve given a normal distribution

$P_n(1)$	$P_n(2)$	$P_n(3)$	$P_n(4)$	$P_n(5)$	$P_n(6)$	$P_n(7)$	$P_n(8)$
0.13%	2.15%	13.59%	34.13%	34.13%	13.59%	2.15%	0.13%

As most funds do not have normally distributed returns, the actual probability of their returns falling into one of these eight sections may deviate from that implied by the normal curve. The formula described below compares each section of the fund's actual distribution to that of a normal curve. We then sum the comparative ratios above the mean to create V_2 as well as the ratios below the mean to create V_1. The ratio of V_1 over V_2 is used to calculate V. This scales the standard deviation to increase or decrease it depending on the shape of the fund's distribution curve.

$$X = S * V$$

$$V = \left(\frac{V_1}{V_2}\right)^{0.25}$$

$$V_1 = \frac{P_a(1)^{0.5}}{P_n(1)^{0.5}} + \frac{P_a(2)^{0.5}}{P_n(2)^{0.5}} + \frac{P_a(3)^{0.5}}{P_n(3)^{0.5}} + \frac{P_a(4)^{0.5}}{P_n(4)^{0.5}}$$

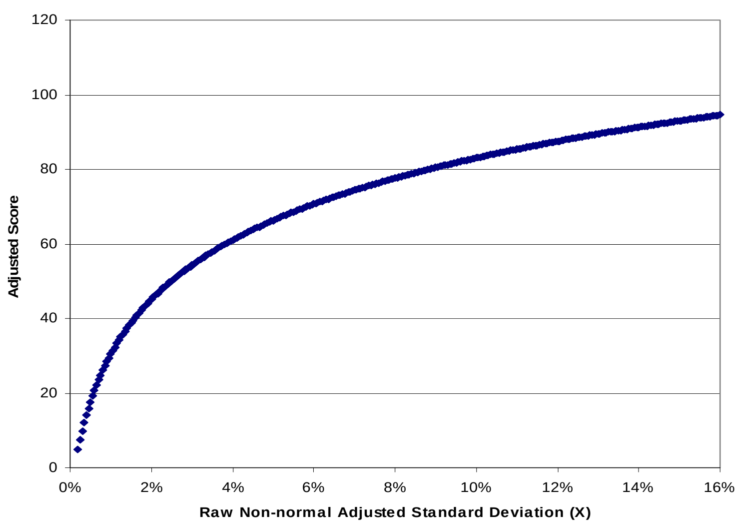
$$V_2 = \frac{P_a(5)^{0.5}}{P_n(5)^{0.5}} + \frac{P_a(6)^{0.5}}{P_n(6)^{0.5}} + \frac{P_a(7)^{0.5}}{P_n(7)^{0.5}} + \frac{P_a(8)^{0.5}}{P_n(8)^{0.5}}$$

Where:
$\mathbf{P_a}$**(**1,2,3,4,5,6,7,8**)** is the probability of the returns falling in the specified section based on the funds actual returns.

$\mathbf{P_n}$**(**1,2,3,4,5,6,7,8**)** is the probability of the returns falling in the specified section based on a normal distribution.

Transition Formula

$$F_4 = 25*Ln(0.0025*X) + 140$$



Greenberg Silverstein Risk Assessment

$$GSRM = 1 + B_1*F_1 + B_2*F_2 + B_3*F_3 + B_4*F_4$$

Where B_i represents the beta corresponding to each factor.

The weights are based on the betas provided from the multiple regression analysis of the risk scores on the sample data as applied to the four factors described above and are as follows:

$B_1 = 0.41$
$B_2 = 0.10$
$B_3 = 0.28$
$B_4 = 0.21$

Greenberg Ratio

$$GR = \frac{30*(R - R_F)}{e^{(0.025*GSRA)}}$$

Where:
R is the annualized return for the period that is being evaluated
R_F is the annualized risk free rate (three month Libor) the period that is being evaluated
GSRA is the risk score for all available historical data.

Each fund will have four risk adjusted returns based upon the data over; the last 6 months, the last 12 months, the last 24 months and one that includes all historical data. There will also be an average risk adjusted return score that will be the average of these four scores.

Note: if (R - RF) is negative the alternative formula below is used. This is done to address the problem that all current risk adjusted ratios have, which is that if the numerator is negative the denominator has an inverse effect on the ratio. This causes a fund with a higher risk statistic but the same (negative) return to appear better than one with a lower risk statistic.

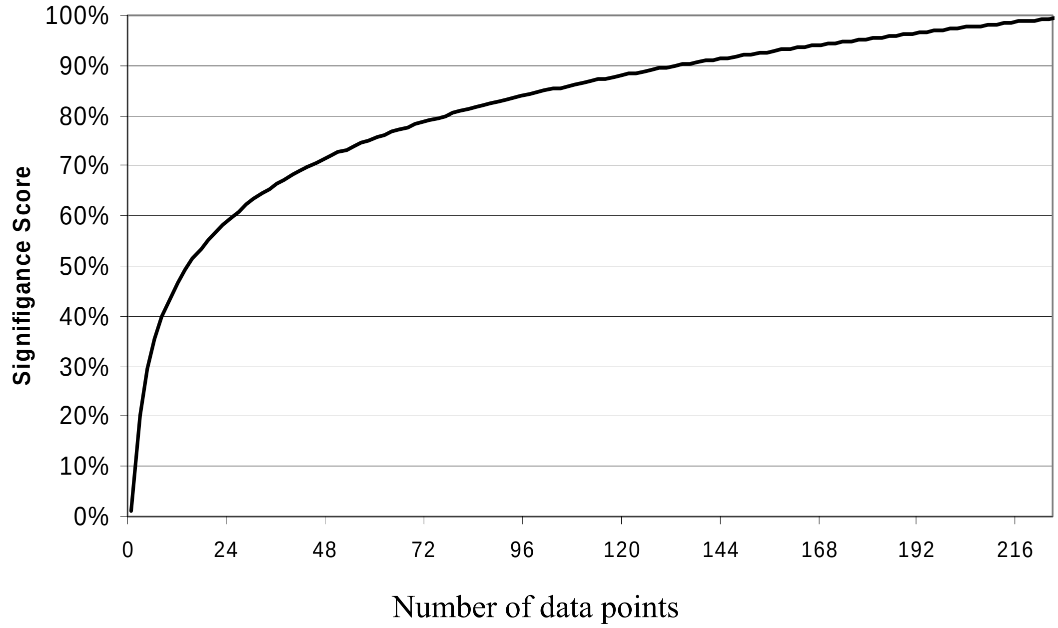
$$GR = 30*(R - R_F)*e^{(0.025*GSRA)}$$

Significance Score

$$W = 1 - (-0.1851 * Ln(n) + 1.0106)$$

The significance score was created by taking a fund with n data points and backfilling the data randomly to see how much the risk score could vary by. The final significance score had 0.98 R-squared value with the actual variation of the scores.

A qualitative overlay may be added to this in the future which will allow for the use of pro-forma or manager's older track records to be evaluated.



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