AMERICAN ACADEMY *of* ACTUARIES

# Follow-up to Proposed New Risk-Based Capital Method for Separate Accounts that Guarantee an Index

**Presented by the American Academy of Actuaries' Life Capital Adequacy Subcommittee to the National Association of Insurance Commissioners' Life Risk-Based Capital Working Group**

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This recommendation is a modification of the Academy's March and June 2002 proposals. Comment letters were received by the LRBC Working Group that raised significant concerns, and that the subcommittee felt needed to be addressed. The subcommittee addresses these issues in the following revised proposal. There are still some concerns that need to be resolved with additional research, which is explained in this document. We do not believe that resolution of these concerns will result in changing the basic framework that is being proposed, however, it could result in modifications or calibration adjustments to the proposed factors.

The recommendation was prepared by a subgroup (chaired by Luke Girard) of the Life Capital Adequacy Subcommittee. The subgroup is made up of various members of the subcommittee as well as Jack Gies, Jerry Holman, and Dennis Lauzon.

The current "Overview and Instructions" states that, "Indexed separate accounts are invested to mirror an established securities index that is the basis of the guarantee. Consequently, indexed separate accounts are relatively low risk; the risk-based capital factor is the same as class 1 bonds." Class 1 bonds have a (C-1) factor of 0.4 percent. Since the formula was developed, it has become clear that, in many instances, companies that guarantee an index do not follow an investment strategy that tracks as closely as this factor implies. Since the number of possible investment and index strategy combinations is very large, tabular factors and a standardized modeling approach do not appear to be practical.

In the previous proposal, the American Academy of Actuaries' Life Capital Adequacy Subcommittee (subcommittee) had recommended a single tracking error approach, based on the specific actual historical performance of the guaranteed index separate account. The method would calculate truncated or downside risk only statistics using the tracking error data over the historical period. These statistics would then be used as inputs into a formula that would produce the desired Risk-Based Capital (RBC) charge. This formula was calibrated to produce sufficient capital to offset losses at the 95 percent confidence level over a two-year period. This calibration was based on the assumption that the tracking error is normally distributed. The method also included an adjustment if the separate account contained high yield securities, but excluded adjustments for other risky asset classes or strategies.

The previous proposal raised several concerns, which are summarized below:

- Many companies follow an investment strategy that is similar to, if not identical to, the strategy being followed in the general account. The proposed method could result in RBC being considerably higher or lower than similar strategies being followed in the general account. This is controversial for several reasons. First, the level of RBC for general account strategies is well established and accepted as the appropriate level by the various constituencies. A different standard for essentially the same risk is inappropriate. Second, a double standard could encourage some companies to design products that take advantage of the lower RBC treatment. Third, general account strategies normally involve a significant component of illiquid investments such as privates, commercial mortgage loans, and real estate. These asset classes are not actively traded, and as a consequence, valuation is conducted using internal pricing procedures. Such pricing procedures may significantly understate tracking error relative to publicly traded securities.

- The previously proposed tracking error approach is based on the assumption that the underlying distribution is a normal distribution. The method could significantly overstate or understate the appropriate level of RBC, if the underlying distribution is skewed or there is serial correlation in the underlying tracking error data. The method for adjusting for high yield securities is complex, difficult to implement, and would result in double counting risk in these securities (once in the tracking error and again in the adjustment that is proposed).

The subcommittee's revised recommendation is based on an approach that builds on the previous tracking error proposal and is summarized as follows, with additional details in the appendices.

This approach distinguishes between two different categories of strategies and proposes different RBC treatment for each strategy. Appendix A provides reasons why one single method is not achievable for these types of separate accounts.

*Class I Strategies:* Under the first class of strategies, the company invests deposits made into the separate account much in the same way as it would for deposits in the general account. The characteristics of the asset strategy would include investment grade and below investment grade corporate bonds, private placements, commercial loans, and various alternative investment strategies that are normally associated with general account investing. If the guaranteed index obligation is not similar in nature to a traditional general account fixed annuity, the company will transform the financial characteristics of the obligation, using a replication strategy, to those characteristics that are similar to a traditional general account fixed annuity. The frequency of valuation can be as infrequent as quarterly and will usually not be more frequent than monthly. For this class of strategies, the Look-Through Method would apply, that is, the current general account C1 and C3 factors would apply.

*Class II Strategies:* Under the second class of strategies, the company does not follow a traditional general account investment strategy when investing deposits. Under this strategy, the company is buying securities that are either included in the underlying index or are highly correlated with these underlying securities. Alternatively, strategies could be designed to be market neutral in aggregate that are not normally associated with general account investing.[1] The frequency of valuation for the second class is much more frequent and can be daily, weekly, but not less often than monthly. For this class of strategies, the Empirical Tracking Error Method would apply. This method will produce factors similar to the current factor for relatively passive strategies (e.g., buy T-Bills and S&P futures), but much higher factors if credit, duration, or basis risk is significant.

Below is a high level summary of the Look-Through and Empirical Tracking Error Methods.

*Look-Through Method:*

- For C1 risk, apply the same factors to the asset statement values that are applicable to the general account.

[1] For market neutral strategies we mean investment strategies can be generically defined as being designed to produce returns, commonly by holding offsetting positions, which are independent of the returns of the market or market sector of those positions. A portfolio is considered market neutral if a material portion of its expected return is from market neutral strategies and it has an expected return (with an acceptable level of volatility) that is not strongly correlated to a given market, e.g., equity or bond market.

- For C3 risk, the factors will depend on whether or not the company is exempted from the C3 cash flow testing requirement.
- If the company is not exempted, the company is required to perform cash flow testing to determine the amount of C3 RBC, using the same approach that is used for the general account and subject to the same minimum and maximum. Consistent with general account products, the company must submit an unqualified Section 8 opinion, under the revised Standard Valuation Law, to be eligible for a credit of one-third of the RBC otherwise needed.
- If the company is exempted, the C3 factor will be based on a stress test for a significant upward movement in interest rates. The factor is the percent change in the market value of the asset portfolio based on the 95$^{th}$ percentile interest rate change over one year. For the five-year constant maturity treasury, this statistic is 197 basis points. (Source: H.15 Release -- Federal Reserve Board of Governors: April 1953 to September 2002). To allow for additional spread risk, it is recommended that this stress test be set at 250 basis points.
- Whether or not exempted from cash flow testing, an additional charge of 0.4 percent is applied to the statement value of the liabilities for potential additional separate account replication strategy risks.

*Empirical Tracking Error Method:*

A step by step description of the procedure to calculate the charge is found in Appendix B, as it would likely appear in the O&I. Below is a high level summary with comments.

- This RBC charge is for both C1 and C3 risk.
- Determine a monthly series of net tracking errors (fund performance minus guaranteed performance) for the most recent 60 months. This series represents an exact historical fit of the results of the company's strategies. As such, it retains any time-dependence serial correlation embedded in the data and it does not rely on the assumption of normality.
- For each month 24 to 60 in the series, calculate the sum of the tracking errors over the last 12 and 24 months and take the worst case of these two statistics. The result will be a series of 37 statistics. With this series, calculate the 90$^{th}$ percentile Conditional Tail Expectation (CTE).
- For start-up funds, where there is less than 24 months of history, a static charge of X percent would apply. This charge would be set at a reasonably conservative level, but would not be punitive. It would be a temporary assessment until enough history has developed to produce a reliable tracking error measure. Reliance on this static charge would be gradually phased out as the company achieved 60 months of experience and completely phased out when 60 months of data is achieved. In start up situations, the funds involved should be small relative to the size of the entire company; therefore any error should be immaterial.
- For small separate accounts, where the statement value of the separate account is less than 10 percent of company total adjusted capital, the company would be permitted to use the X percent static factor, instead of the tracking error method. For companies that do not have 60 months of historical monthly data on the effective date of this

amendment, a company would be permitted to use the X percent static charge and gradually phase into the tracking error method.

- The company should be permitted to phase out reliance on the X percent factor sooner, if it is able to, and chooses to calculate weekly tracking errors. In this case, the phase-out would occur over a period of two to three years. The LCAS subgroup is currently researching whether a suitable formula can be found that accomplishes this.
- The resulting RBC factor is subject to a minimum 0.4 percent.

**Additional Research - Tracking Error Method**

In the subgroup's discussions, one significant remaining issue has not yet been resolved. Different members have described this issue differently, however, we believe it is essentially the same issue. We do not believe that resolution of these concerns will result in changing the basic framework that is being proposed, however, it could result in modifications or calibration adjustments to the proposed factors.

One description of the issue is that the calculated result, using the proposed method, will always produce a charge that will prove to be inadequate over the entire five-year period. This is so because the resulting calculation is the $90^{th}$ percentile CTE over the five-year period and this is always less than the $100^{th}$ percentile or worst case result. The alternate description is that we may have sampling error or an implicit statistical bias in the methodology we are employing. To resolve this concern, we may need to make an adjustment to the final result (possibly an error term or margin) that may depend on the credibility and/or the volatility of the sample size.

Alternatively, a modification to the tracking error method presented in this proposal is being considered. This method is referred to as the "Transform Method" and is attached to this proposal as Appendix C. The method is a linear transformation of the historical tracking error series that preserves the moments of the historical distribution. The method avoids the problem of summing overlapping twelve and twenty-four month data series, and can be extended to a series of weekly tracking errors taken over a shorter time period than the 60-month period. An example of the application of the transform method is included in the attached MS Excel spreadsheet.

Although the subcommittee is still discussing these issues, we expect their resolution to a satisfactory enough degree to be in a position of recommending the implementation of this proposal. Our hope and goal is to arrive at an adjustment that is either no adjustment at all or the adjustment will result in simple modification that is easily implementable within the short time-frame that we are facing.

## Appendix A

**Reasons why the Tracking Error Method is unacceptable for strategies falling in the first class**

- The investment risks are very similar to those risks inherent in a general account investment strategy. A significantly different RBC level for essentially the same risk would be controversial. The RBC level applicable to general account investments is well established. It has received a great deal of scrutiny by the industry and by regulators, and studies and research have supported it.
- A different treatment for the same risk may provide incentives to company management for designing products that take advantage of the most favorable RBC treatment.
- The method of valuation for this class of strategies is infrequent and will usually rely on internal pricing models to value illiquid asset classes such as privates, commercial mortgage loans, and private placements. The historical period required to produce a statistically significant tracking error will require several years of data and the company may have made material changes in its strategy over this period of time

**Reasons why the Look-Through Method is unacceptable for the second class of strategies**

- This method could significantly overstate the appropriate level of RBC. For example, if the strategy is replicating an equity index, the resulting RBC will be entirely based on the very high equity RBC factors.
- This method could significantly understate the appropriate level of RBC. For example, if the strategy is replicating a high quality bond index, the resulting RBC will be entirely based on the low RBC factors applicable to high quality bonds.

**Appendix B**
**Empirical Tracking Error Method**

1. Determine the series {X(t)} as actual net tracking error (fund performance minus guaranteed performance) for the most recent 60 months.

2. For each month 24 to 60 of the series, determine the lesser of the sum of results for the last 12 and the last 24 months giving 37 minima. At time $t \geq 24$, let $S(t)=\min\{A(t, j): j=1 \text{ or } 2\}$ where $A(t, j)=\text{sum}\{X(t-24+k) \text{ for } k=1..12j\}$.

3. Order the series S(t) in ascending order. Set any positive values to zero. Average the first three values and the first four values. Calculate the sum of 30 percent of the average of the first three values in the series and 70 percent of the average of the first four values in the series. Change the sign and the result is the $90^{th}$ percentile CTE capital for C1 and C3.

4. Where there is less than 27 months of tracking error history the capital charge for C1 and C3 is X percent. If we have 27 months or higher of history, the X percent factor is gradually phased out. For 27 months, we have four minima and we follow the steps 2 and 3 above and weight the result by the square root of 4/37 and the X percent factor by 1 minus the square root of 4/37. For 28 months, we have five minima and we follow steps 2 and 3 above and weight the result by the square root of 5/37 and the X% factor by one minus the square root of 5/37, and so on. For 59 months, we have thirty-six minima and we follow steps 2 and 3 above and weight the result by the square root of 36/37 and the X percent factor by one minus the square root of 36/37.

5. The resulting RBC factor is subject to a minimum 0.4 percent.

## Appendix C
## Tracking Error / Transform Method

### Overview

This method is an alternative to the Empirical Tracking Error method defined in Appendix B. It uses the same data input, the monthly tracking error, but treats the data differently. The method addresses concerns that using rolling averages under the Empirical Tracking Error can result in unwarranted serial correlation or a biased result. This can happen because data points in the middle of the series, receive greater weight in the calculated rolling averages than data at the beginning and end of the series.

The transform method converts each monthly tracking error data point into the expected two-year equivalent result, giving due consideration to the nature of the distribution of the observed monthly tracking error data. In this manner, the amount of useful information about the distribution is increased because the transform of each monthly data point to the two-year equivalent becomes an input to the measuring 90 percent CTE statistic used to derive the RBC amount.

The general form of transforming the monthly net return series X, with mean m, to a two-year horizon net return series Y is given by the formula,

$Y = (X - m)*K + 24*m.$

The appropriate selection of K in this formula results in a precise appraisal of the nature of the distribution. Specifically,

- Y has the mathematically correct standard deviation that reflects the standard deviation of X and any serial correlation
- All statistical properties implied by the monthly data series are replicated and no unintended assumptions are made (such as unwarranted serial correlation due to 23-month overlap in a solvency look back)
- No distributional assumption is made which would fail to fit unanticipated distributions

These characteristics taken together further imply that, skewness and all higher statistical moments for X about its mean are replicated by Y as well. The result of this is that in a precisely defined sense, Y is the perfect transformation to the longer two-year horizon because it replicates all of the statistics conveyed by X. For the special case of no serial correlation, we will see that the familiar proportionality of standard deviation to the square root of time applies to derive K = square root of (24).

**Derivation**

The derivation below assumes 60 months of data are available. The RBC Calculation Instructions below, address transitional situations with less than 60 months of available data.

Let $Z = X_1 + X_2 + \ldots + X_{24}$ where the Xi are identically distributed consecutive monthly net returns with mean and standard deviation m and s. Let s' = the standard deviation of Z, reflecting any significant serial correlation between Xi and Xj for all i and j with i < j. Let K = s'/s. Serial correlations or covariances, and their role in deriving s' are discussed more fully below. We can see that Y has the same distributional properties as Z described in the three points below. The first point follows by additivity of expected values, while the second and third points follow by tracking the algebra involved in computing those moments.

- Y has the same mean 24*m, as the two-year horizon return Z
- Y has the standard deviation s' by construction as the two-year horizon return Z
- Y has the same 3rd order and higher moments as either the monthly net return X or the two-year horizon return Z

The impact of serial correlation or covariance is seen through the expansion of the variance of Z into terms involving the Xi's which results in Var(Z) = sum{var(Xi): i} + 2* sum{cov(Xi,Xj): i < j}. s' is found by taking the square root of the variance of Z. We can simplify by using the assumption of common distribution of Xi's, and by grouping cov(Xi,Xj) together into groups for i-j = 1, 2, 3, … 23.

Var(Z) = 24 * s^2 + 2 * sum{(24-j)*cov($X_1$,$X_{1+j}$): j = 1 to 23}.

Thus there are 23 covariances to consider. Note, that due to the covariances being sample estimates, there is a small chance that the calculated variance could be negative which would result in an undefined standard deviation s. This is a theoretical impossibility and it is unlikely to occur in a realistic series. The simplest safety measure is to set all covariances equal to zero if this occurs.

**Sample Results**

The following chart gives a sense of the potential differences between the Empirical Tracking Error Method and the Transform Method (with serial correlation). For an illustrative sample 60-month net return series randomly generated by the Excel normal random generator, the 90 percent CTE over a two-year horizon is shown for each method.

| 90% Conditional Tail Expectation | |
|---|---|
| | |
| Empirical T.E. | Transform |
| | |
| 3.09% | 3.62% |

**RBC Calculation Instructions**

1. Determine the series {X(t)} as actual net tracking error (fund performance minus guaranteed performance) for the most recent 60 months.

2. Convert each value X(t) to a value Y(t) using the formula, Y = (X -m)*K+24*m

   Where m is the mean of the series {X(t)} and K is an adjustment factor to account for the variance of the distribution Y including serial correlation. If there is no serial correlation K will equal SQRT(24), (K can be determined using a spreadsheet that will be provided).

3. Order the series {Y(t)} in ascending order. Set any positive values to zero. Average the first six values. Change the sign and the result is the $90^{th}$ percentile CTE capital for C1 and C3.

4. Where there is less than 30 months of tracking error history the capital charge for C1 and C3 is X percent. If we have 30 months or higher of history, the X percent factor is gradually phased out. For 30 months, actual experience is weighted by the square root of 30/60 and the X percent factor is weighted by one minus the square root of 30/60. For 31 months experience is weighted by the square root of 31/60 and the X percent factor is weighted by one minus the square root of 31/60. This pattern continues up to month 59 when experience is weighted by the square root of 59/60 and the X percent factor is weighted by 1 minus the square root of 59/60.

   The experience based calculation under step (3) above, needs to be adjusted when there are less than 60 months of experience to gauge the 90 percent CTE. If the number of months divided by 10 is an integral number "n", take the average of the first "n" values after the series is put in ascending order with positive values set to zero. If "n" is non integral, then set "n" to the next highest integral number and interpolate, using each average of the of the first "n-1" and "n" values after the series is set in ascending order and positive values are set to zero. For example, if there are 37 values the idea is to identify the worst 3.7 of them. This is done by interpolating, taking 30 percent of the average of the first three values and 70 percent of the average of the first four values.

5. The resulting RBC factor is subject to a minimum 0.4 percent.

| | | | | |
|---|---|---|---|---|
| **pctCTE** | **10%** | **Empirical Tracking Error Method (Appendix B)** | | |
| **apply cov=** | **2** | | | |
| **horiz=** | **24** | | N= | 37 |
| | | | rank cutoff= | 3.7 |
| | | | (a) rank= | 3 |
| | | | (a) wt= | 30% |
| | | | (a) avg= | 3.24% |
| | | | (b) rank= | 4 |
| | | | (b) wt= | 70% |
| | | | (b) avg= | 3.02% |
| | | | **target CTE =** | **3.09%** |

**illustrative tracking error series**

| month | **tracking error X** | min of 1, 2 yr cumulative returns | rank |
|---|---|---|---|
| 1 | -1.24% | NA | NA |
| 2 | 0.19% | NA | NA |
| 3 | -0.27% | NA | NA |
| 4 | 0.51% | NA | NA |
| 5 | 0.22% | NA | NA |
| 6 | 0.10% | NA | NA |
| 7 | -0.05% | NA | NA |
| 8 | 0.69% | NA | NA |
| 9 | 0.54% | NA | NA |
| 10 | 0.42% | NA | NA |
| 11 | -0.30% | NA | NA |
| 12 | 0.60% | NA | NA |
| 13 | 0.37% | NA | NA |
| 14 | 0.14% | NA | NA |
| 15 | -0.11% | NA | NA |
| 16 | -0.86% | NA | NA |
| 17 | -0.48% | NA | NA |
| 18 | -0.04% | NA | NA |
| 19 | -0.35% | NA | NA |
| 20 | -0.32% | NA | NA |
| 21 | 1.14% | NA | NA |
| 22 | 0.06% | NA | NA |
| 23 | -0.41% | NA | NA |
| 24 | -1.05% | -0.51% | 16 |
| 25 | -0.95% | -0.21% | 23 |
| 26 | -0.02% | -0.42% | 18 |
| 27 | 0.16% | 0.00% | 25 |
| 28 | 0.20% | -0.31% | 21 |
| 29 | 0.24% | -0.29% | 22 |
| 30 | 0.24% | -0.15% | 24 |
| 31 | -0.32% | -0.41% | 19 |
| 32 | 0.31% | -0.79% | 15 |
| 33 | 0.06% | -1.26% | 12 |
| 34 | -0.05% | -1.73% | 8 |
| 35 | -0.59% | -2.02% | 6 |
| 36 | 0.24% | -2.38% | 4 |

| pctCTE | Tracking Error/Transform Method (Appendix C) | | | |
|---|---|---|---|---|
| | | | lookback horizon= | 24 |
| apply cov= | 2 yr horizon, Y=(X-m)*s'/s+horiz*m | | N= | 60 |
| horiz= | monthly mean= | 0.11% | rank cutoff= | 6 |
| | | | rank1= | 6 |
| | | | rank2= | 7 |
| | | | weight1= | 1 |
| | | | weight2= | 0 |
| | | | CTE1= | 3.62% |
| | | | CTE2= | 3.24% |
| | | | **target CTE =** | **3.62%** |

| Statistics of transformed series | | |
|---|---|---|
| | monthly series | transformed series |
| mean= | 0.11% | 2.63% |
| stdev= | 0.54% | 3.34% |
| skewness= | 0.063078055 | 0.063078055 |
| min= | -1.24% | -5.65% |
| max= | 1.66% | 12.15% |
| max-min= | 2.90% | 17.80% |
| COVARIANCE= | 0.000202 | |
| s(horizon\|cov<>0) | 3.34% | |
| s(horizon\|cov=0)= | 2.67% | |

**illustrative tracking error series**

| month | transformed to horizon Y | |
|---|---|---|
| 1 | -5.65% | 1 |
| 2 | 3.13% | 34 |
| 3 | 0.30% | 14 |
| 4 | 5.10% | 48 |
| 5 | 3.28% | 36 |
| 6 | 2.55% | 29 |
| 7 | 1.63% | 21 |
| 8 | 6.17% | 55 |
| 9 | 5.25% | 49 |
| 10 | 4.52% | 44 |
| 11 | 0.10% | 13 |
| 12 | 5.66% | 52 |
| 13 | 4.22% | 42 |
| 14 | 2.79% | 30 |
| 15 | 1.28% | 20 |
| 16 | -3.30% | 4 |
| 17 | -0.98% | 7 |
| 18 | 1.74% | 23 |
| 19 | -0.20% | 10 |
| 20 | 0.01% | 11 |
| 21 | 8.97% | 58 |
| 22 | 2.31% | 26 |
| 23 | -0.56% | 8 |
| 24 | -4.48% | 2 |
| 25 | -3.85% | 3 |
| 26 | 1.83% | 24 |
| 27 | 2.91% | 32 |
| 28 | 3.19% | 35 |
| 29 | 3.40% | 37 |
| 30 | 3.44% | 38 |
| 31 | 0.02% | 12 |
| 32 | 3.85% | 41 |
| 33 | 2.35% | 27 |
| 34 | 1.64% | 22 |
| 35 | -1.67% | 6 |
| 36 | 3.45% | 39 |

| | | | | |
|---|---|---|---|---|
| **pctCTE** | **10%** | **Empirical Tracking Error Method (Appendix B)** | | |
| **apply cov=** | **2** | | | |
| **horiz=** | **24** | | N= | 37 |
| | | | rank cutoff= | 3.7 |
| | | | (a) rank= | 3 |
| | | | (a) wt= | 30% |
| | | | (a) avg= | 3.24% |
| | | | (b) rank= | 4 |
| | | | (b) wt= | 70% |
| | | | (b) avg= | 3.02% |
| | | | **target CTE =** | **3.09%** |

**illustrative tracking error series**

| month | **tracking error X** | min of 1, 2 yr cumulative returns | rank |
|---|---|---|---|
| 37 | 0.47% | -3.22% | 2 |
| 38 | 0.50% | -3.38% | 1 |
| 39 | 0.14% | -3.11% | 3 |
| 40 | -0.11% | -2.05% | 5 |
| 41 | 0.64% | -1.34% | 11 |
| 42 | 0.39% | -1.06% | 13 |
| 43 | 0.89% | -1.02% | 14 |
| 44 | 0.77% | -0.40% | 20 |
| 45 | 0.16% | -1.48% | 10 |
| 46 | -0.36% | -1.59% | 9 |
| 47 | 0.08% | -1.77% | 7 |
| 48 | -0.20% | -0.47% | 17 |
| 49 | 0.61% | 0.95% | 26 |
| 50 | -0.24% | 1.47% | 29 |
| 51 | 0.47% | 1.46% | 28 |
| 52 | 0.57% | 1.14% | 27 |
| 53 | 1.35% | 1.55% | 30 |
| 54 | 1.66% | 1.69% | 31 |
| 55 | 0.25% | 2.90% | 32 |
| 56 | 0.00% | 3.36% | 34 |
| 57 | -0.16% | 3.46% | 36 |
| 58 | -0.12% | 3.15% | 33 |
| 59 | 0.57% | 3.82% | 37 |
| 60 | -0.77% | 3.37% | 35 |

| pctCTE | Tracking Error/Transform Method (Appendix C) | | | |
|---|---|---|---|---|
| | | | lookback horizon= | 24 |
| apply cov= | 2 yr horizon, Y=(X-m)*s'/s+horiz*m | | | |
| horiz= | monthly mean= | 0.11% | N= | 60 |
| | | | rank cutoff= | 6 |
| | | | rank1= | 6 |
| | | | rank2= | 7 |
| | | | weight1= | 1 |
| | | | weight2= | 0 |
| | | | CTE1= | 3.62% |
| | | | CTE2= | 3.24% |

| Statistics of transformed series | | |
|---|---|---|
| | monthly series | transformed series |
| mean= | 0.11% | 2.63% |
| stdev= | 0.54% | 3.34% |
| skewness= | 0.063078055 | 0.063078055 |
| min= | -1.24% | -5.65% |
| max= | 1.66% | 12.15% |
| max-min= | 2.90% | 17.80% |
| COVARIANCE= | 0.000202 | |
| s(horizon\|cov<>0) | 3.34% | |
| s(horizon\|cov=0)= | 2.67% | |

| illustrative tracking error series | | target CTE = | 3.62% |
|---|---|---|---|
| month | transformed to horizon Y | | |
| 37 | 4.85% | | 46 |
| 38 | 5.04% | | 47 |
| 39 | 2.83% | | 31 |
| 40 | 1.26% | | 19 |
| 41 | 5.88% | | 54 |
| 42 | 4.36% | | 43 |
| 43 | 7.40% | | 57 |
| 44 | 6.68% | | 56 |
| 45 | 2.96% | | 33 |
| 46 | -0.26% | | 9 |
| 47 | 2.43% | | 28 |
| 48 | 0.70% | | 16 |
| 49 | 5.70% | | 53 |
| 50 | 0.46% | | 15 |
| 51 | 4.82% | | 45 |
| 52 | 5.48% | | 51 |
| 53 | 10.22% | | 59 |
| 54 | 12.15% | | 60 |
| 55 | 3.47% | | 40 |
| 56 | 1.94% | | 25 |
| 57 | 0.97% | | 17 |
| 58 | 1.22% | | 18 |
| 59 | 5.44% | | 50 |
| 60 | -2.78% | | 5 |