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

Philadelphia, PA – June 2002

The American Academy of Actuaries is the public policy organization for actuaries practicing in all specialties within the United States. A major purpose of the Academy is to act as the public information organization for the profession. The Academy is non-partisan and assists the public policy process through the presentation of clear and objective actuarial analysis. The Academy regularly prepares testimony for Congress, provides information to federal elected officials, comments on proposed federal regulations, and works closely with state officials on issues related to insurance. The Academy also develops and upholds actuarial standards of conduct, qualification and practice and the Code of Professional Conduct for all actuaries practicing in the United States.

Life Capital Adequacy Subcommittee

Alastair G. Longley-Cook, F.S.A., M.A.A.A., Chair
Robert A. Brown, F.S.A., M.A.A.A., Vice-Chair

Gerald A. Anderson, F.S.A., M.A.A.A.
Stephen M. Batza, F.S.A., M.A.A.A.
Jeffrey M. Brown, F.S.A., M.A.A.A.
Martin Claire, F.S.A., M.A.A.A.
Joseph L. Dunn, F.S.A., M.A.A.A.
Luke N. Girard, F.S.A., M.A.A.A.
Arnold N. Greenspoon, F.S.A., M.A.A.A.
David E. Neve, F.S.A., M.A.A.A.
Keith D. Osinski, F.S.A., M.A.A.A.
Jan L. Pollnow, F.S.A., M.A.A.A.
Craig R. Raymond, F.S.A., M.A.A.A.
James F. Reiskytl, F.S.A., M.A.A.A.
Michael S. Smith, F.S.A., M.A.A.A.
James A. Tolliver, F.S.A., M.A.A.A.
George M. Wahle, F.S.A., M.A.A.A.
Bill Wilton, F.S.A., M.A.A.A.
Michael L. Zurcher, F.S.A., M.A.A.A.

This recommendation is the same as contained in the Academy's March 2002 proposal. The report has been expanded to outline the methodology underlying the formulas.

The current "Overview and Instructions" says 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 .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 strategies is very large, tabular factors or a standardized modeling approach do not appear to be practical. In the absence of these methods, the American Academy of Actuaries' Life Capital Adequacy Subcommittee recommends an approach that reflects actual loss volatility and adjusts the result for exposure to lower rated debt. This approach 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.

The proposed new method is as follows:

a) Calculate the "tracking error" as periodic (monthly or weekly) fund performance (net of fees) minus the guaranteed performance (after fees) for the 100 most recent months (if the product has 100 months of history, otherwise the 100 most recent weeks or the lifetime of the fund, if shorter). If the product has less than 100 months of history and weekly data is unavailable, see Appendix 1.

b) For periods in which the difference is positive, record a value of zero; if negative, retain the calculated value.

c) Calculate the mean and standard deviation of these results.

d) Calculate the initial RBC percentage as follows, where m is the calculated mean and s is the calculated standard deviation: Calculate "a" as 1.34 + m/s. As explained in Appendix 3, all factors and limits were empirically developed.

-- For monthly data, the initial capital requirement is –24 * (m + a*s) + 13.5 * s
-- For weekly data, the requirement is –104* (m + a*s) + 28.5 * s
--For quarterly data, the requirement is –8*(m+a*s) + 7.8 * s
Apply the above percentage to the accumulated guaranteed value.

e) Adjust for below investment grade securities. If the portfolio has included securities in Class 3 or higher during the measurement period, an adjustment must be made following one of the following two alternatives:

i) In calculating tracking error, replace the Class 3 and higher securities actual results, with those of Treasury bonds of similar duration. Then, add the C-1 factor amounts for these securities to the total, as calculated above.

OR

ii) Calculate the tracking error for the actual portfolio (without adjustment), then add the excess C-1 factor above the Class 2 amount for those securities in Class 3 or higher.

f) If the result of the above calculations is less than .4 percent times the accumulated guaranteed amount, increase it to that level.

This calculation is to be done for each distinct guarantee/portfolio combination separately.

Since the tracking error reflects the impact of any duration mismatches, guaranteed index separate account products do not get a C3a charge.

All the above is pre-tax, and should be fully tax adjusted by multiplying by 1 minus the corporate tax rate..

APPENDIX 1: How to proceed if the product does not have 100 months of data and weekly data is unavailable.

If weekly data can be produced for future periods, use monthly (or quarterly if monthly is unavailable) data for prior periods to develop a capital formula percentage. Use weekly data going forward to develop a capital formula. Combine these into a combined annualized mean and standard deviation by time weighting the results, i.e. if there were 3 years of monthly data and 1 year of weekly data, the capital requirement would be calculated as .75 times the monthly result plus .25 times the weekly result.

If weekly data cannot be produced, then use monthly (or quarterly) data throughout.

APPENDIX 2: Support for how to annualize the monthly mean of the truncated tracking error.

The attached spreadsheet helps demonstrate the need for a special method of annualization. It shows the distribution of annual values of a variable with an annual mean of zero and annual standard deviation of 1. The outcomes are in Column A, the density in Column B, their product in Column C, and A*A*B in Column F.

Untruncated, sum(x)=C163=0, sum(x*x)=F163=19.98, n=B163=20. With truncation at zero, sum(x)=E82=-7.975, sum(x*x)=F163/2=9.99, n=the sum of the "density" column=20.

Since standard deviation = {(n*sum((x*x)-(sum(x))^2)/(n*n)}^.5, the untruncated data gives us {(20*19.98-0)/400}^.5 = 1.00 s.d, mean of 0/20=0.

Truncated we get {(20*9.99-7.975^2)/400}^.5 = .584 s.d and mean = -7.975/20 = -.399.

If, instead, we wanted the statistics for this same distribution, but tabulating monthly results, we can get that simply by dividing all the values in Column A by 12^.5 (since the mean of the untruncated distribution is zero and the monthly standard deviation equals the annual standard deviation divided by 12^.5). This produces a measured monthly mean of truncated values of -.399/12^.5 and monthly standard deviation of .584/12^.5

If we attempt to annualize this mean by multiplication by 12, it produces -1.38 for the annual mean, but the correct value is -.399. This shows the need for a significant correction. The formula provided reflects that correction.

APPENDIX 3: Derivation of formula to annualize the mean and standard deviation of the truncated distribution.

The relationship between the modal (weekly or monthly) and annual values of the mean and standard deviation of the truncated distribution is a function of the ratio of the mean and standard deviation. Table A was developed in order to create a workable formula. It shows the values of the annual, monthly, and weekly mean and standard deviation of both a truncated and untruncated normal distribution with an annual untruncated standard deviation of 1 and a range of means.

The factors used in the RBC formula were empirically developed to produce a good fit to the 2-year 95th percentile values across this range of values.

Since the 95th %tile is 1.65 standard deviations out on the untruncated distribution, the target value for a mean of .50 would be 1.65 * (standard deviation) * square root(years) – (years) * (mean) which would equal 1.65 * 1 * 2^.5 - .50 * 2 = 1.33. Table B shows that the outcome of the recommended formula applied to the truncated factors from Table A is 1.71 (monthly data) or 1.93 (weekly data), so the formula produces a somewhat conservative result in this situation.

Table B shows the ideal value and calculated value for a range of mean to standard deviation ratios.

TABLE A: How Statistical Values for a Truncated Normal Distribution Compare to the Untruncated Value

MEAN = 1*

Modal Frequency:	Annual	Monthly	Weekly	Quarterly
Modal Mean	1	0.0833	0.01923	0.25
Truncated Modal Mean	-0.0832	-0.0782	-0.04623	-0.0988
Modal s.d	1	0.2887	0.1378	0.5
Truncated Modal s.d.	0.2608	0.1397	0.07431	0.2063

*Mean of normal distribution before truncation

MEAN = .75

Modal Mean	0.75	0.0625	0.01442	0.1875
Truncated Modal Mean	-0.131	-0.0866	-0.04839	-0.1196
Modal s.d	1	0.2887	0.1378	0.5
Truncated Modal s.d.	0.3332	0.1469	0.07598	0.2272

MEAN = .5

Modal Mean	0.5	0.0417	0.00962	0
Truncated Modal Mean	-0.1976	-0.0955	-0.05064	-0.1431
Modal s.d	1	0.2887	0.1378	0.5
Truncated Modal s.d.	0.4123	0.1541	0.07762	0.2487

MEAN = 0

Modal Mean	0	0	0	0
Truncated Modal Mean	-0.399	-0.115	-0.0553	-0.1994
Modal s.d	1	0.2887	0.1378	0.5
Truncated Modal s.d.	0.584	0.1685	0.0809	.0.2918

MEAN = -.5

Modal Mean	-0.5	-0.0417	-0.00962	-0.125
Truncated Modal Mean	-0.6976	-0.1372	-0.06026	-0.2681
Modal s.d	1	0.2887	0.1378	0.5
Truncated Modal s.d.	0.7436	0.1825	0.0842	0.3335

MEAN = -1

Modal Mean	-1	-0.0833	-0.01923	-0.25
Truncated Modal Mean	-1.0832	-0.1616	-0.06546	-0.3488
Modal s.d	1	0.2887	0.1378	0.5

Truncated Modal s.d.	0.8666	0.1961	0.08742	0.3719

MEAN = -2

Modal Mean	-2	-0.1667	-0.03846	-0.5
Truncated Modal Mean	-2.0084	-0.2172	-0.07666	-0.5416
Modal s.d	1	0.2887	0.1378	0.5
Truncated Modal s.d.	0.9798	0.221	0.0937	0.4332

TABLE B: Comparison of "Ideal" Results to Proposed Formula

		Monthly	Weekly	Quarterly
Mean	m=	1	1	1
Ideal Value	iv=	0.333452	0.333452	0.333452
	a=	0.780229	0.717876	0.861086
Formula Result	c=	1.146798	1.377833	0.978404
* see below about values				
Mean	m=	0.75	0.75	0.75
Ideal Value	iv=	0.833452	0.833452	0.833452
	a=	0.750483	0.703122	0.813592
Formula Result	c=	1.415646	1.641977	1.250176
Mean	m=	0.5	0.5	0.5
Ideal Value	iv=	1.333452	1.333452	1.333452
	a=	0.720273	0.687591	0.764608
Formula Result	c=	1.708494	1.928167	1.563396
Mean	m=	0	0	0
Ideal Value	iv=	2.333452	2.333452	2.333452
	a=	0.657507	0.65644	0.656655
Formula Result	c=	2.37579	2.533826	2.338344
Mean	m=	-0.5	-0.5	-0.5
Ideal Value	iv=	3.333452	3.333452	3.333452
	a=	0.588219	0.624323	0.536102
Formula Result	c=	3.18015	3.199668	3.31578
Mean	m=	-1	-1	-1
Ideal Value	iv=	4.333452	4.333452	4.333452
	a=	0.515931	0.591201	0.402113
Formula Result	c=	4.097574	3.924299	4.494852

Mean	m=	-2	-2	-2
Ideal Value	iv=	6.333452	6.333452	6.333452
	a=	0.357195	0.521857	0.089769
Formula Result	c=	6.30174	5.557698	7.400656

* For high ratios of mean to standard deviation, the formula produces a factor which exceeds the ideal value, sometimes by a large amount. Under those circumstances, the capital requirement is still relatively low, however, and such situations may be relatively uncommon. For those reasons, the empirical fit was optimized for low and negative ratios.