Society of Actuaries

Questions and Answers Regarding Mortality Improvement Scale BB

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Questions and Answers Regarding Mortality Improvement Scale BB

The Society of Actuaries has asked the Retirement Plans Experience Committee (RPEC) to provide actuaries with additional background concerning the development and intended use of Scale BB. This document, arranged in question and answer format, is intended as a supplement to the *Mortality Improvement Scale BB Report*. RPEC's intention is for this to be a dynamic document that could be expanded to address additional questions and modified in response to comments from the actuarial community.

The questions and answers in this document have been divided into the following sections:

- Section A: Development of Scale BB
- Section B: Application of Scale BB
- Section C: Two-Dimensional Mortality Improvement Scales
- Section D: Annuity Impact of Moving to Scale BB

Section A: Development of Scale BB

A1. Why did the SOA release an interim mortality improvement scale in early 2012 when it expects to provide an official replacement for Scale AA in late 2013 or early 2014?

Early on in the current Pension Plan Mortality Project, RPEC found that Scale AA was not tracking well with recent mortality improvement trends in the United States. While more time is needed to construct the ultimate replacement for Scale AA, RPEC believes actuaries should have access to an improvement scale that reflects more recent mortality improvement experience. Releasing the interim Scale BB also provides some lead-time to the developers of pension valuation software to enhance their software to handle two-dimensional mortality projection scales (see Question A3 below) and provides RPEC time to gather feedback and respond to questions from the actuarial community.

[May 11, 2012]

A2. Have other actuarial studies corroborated RPEC's findings about recent mortality improvement experience vis-à-vis Scale AA?

Yes; in *Mortality Improvement in the USA: Analysis, Projections and Extreme Scenarios*, Joseph Lu and Wun Wong found that the actual rate of increase in life expectancy has been higher than predicted by Scale AA, particularly for males. Moreover, for both males and females, recent improvement has been even more rapid than predicted by Scale AA. Their results are based on Social Security Administration data (1990-2006) and confirmed by the Human Mortality Database. The SOA Group Annuity Experience Committee found similar results with respect to insurance company annuity experience (*Report of the Group Annuity Experience Committee Mortality Experience for 2003-2006.)*

[May 11, 2012]

A3. Does RPEC plan to make public the two-dimensional arrays of mortality improvement rates described in Section 5.2 of the Exposure Draft?

Yes; the two-dimensional are now available here.

Note that the factors in column heading *y* represent the smoothed changes in mortality rates between calendar year *y-1* and calendar year *y*. Thus, to project RP-2000 base mortality rates beyond 2000 using the full 2D table, an actuary would apply the complement of the rates starting in column 2001 on an age-by-age basis. See also Q&A C3 for more details regarding the projection of base mortality rates using 2D mortality improvement tables.

[May 11, 2012]

A4. Why does the Scale BB Exposure Draft discuss the two-dimensional mortality improvement scales when Scale BB is a one-dimensional (age-only) scale?

As described in Section 5.3 of the Exposure Draft, the age-only Scale BB rates were developed from two-dimensional arrays of mortality improvement rates that are able to reflect age, period and year-of-birth cohort effects. Given the likelihood that the mortality projection scale that will ultimately replace Scale AA will be two-dimensional, RPEC thought it appropriate to alert actuaries and developers of actuarial software of this impending change in mortality projection methodology.

[May 11, 2012]

A5. Analysis performed in connection with the RP-2000 mortality tables showed that base mortality rates varied based on factors such as benefit amount and collar. Has RPEC found any indication that mortality <u>improvement</u> rates in the US are also affected by these factors?

RPEC is reviewing mortality data in light of several studies [US Social Security Administration; ORES Working Paper No. 108, October 2007] that have found correlations between changes in life expectancy and various socio-economic factors. The committee intends to address this issue as part of its ongoing Pension Plan Mortality Study.

[May 11, 2012]

A6. Scale BB is derived from Social Security Administration mortality data. Is this an appropriate basis for mortality improvement trends in uninsured pension plans?

Given that the analysis of mortality improvement trends requires large, consistent blocks of mortality data tracked over long periods of time, it is not unusual for mortality projection scales to be developed from general population data. Section 3.3 of the Exposure Draft shows that the recent mortality improvement experience of two large public pension plans has been similar to that of the Social Security Administration. These are the Federal Civilian pension plans administered by the Federal Office of Personnel Management and the California Public Employees Retirement System (CalPERS).

While the available data for private sector plans are currently insufficient to produce a separate set of private pension mortality improvement rates, RPEC intends to continue its research on this topic as part of the ongoing Pension Plan Mortality Study.

[May 11, 2012]

A7. Does the 1.0% long-term rate, implicit in the development of Scale BB, take into consideration the rise in obesity levels among the US population?

RPEC reviewed numerous studies on the topic of future mortality trends, many of which presented arguments for the slowing of future mortality improvement in the US due to increasing levels of type-2 diabetes, coronary heart disease and cancer, all of which could be linked to rising obesity levels. On the other hand, a number of studies presented arguments for continued (and, in some cases, increasing) improvement in US life expectancies, citing advances in medical technology, genetic engineering and new pharmaceuticals. The 2011 Technical Panel on Assumptions and Methods, in their *Report to the Social Security Advisory Board*, considered factors affecting life expectancy gains, including obesity and smoking, and concluded:

"In 2006, as a consequence of the high prevalence of smoking and obesity, the U.S. life expectancy of 77.7 years was lower than that of most other high-income countries. These behavioral effects will likely continue to depress U.S. life expectancy. Yet, despite their increase for decades, indicators of smoking behavior and obesity have recently plateaued (National Research Council 2011). Therefore, it is reasonable to assume that the adverse impact of these behaviors on life expectancy will remain at current levels rather than continue to rise…"

RPEC placed significant weight on the analyses presented in recent Technical Panel reports in the selection of the 1.0% long-term rate. In particular, the 2007 Technical Panel on Assumptions and Methods recommended that 1.0% be used for the average long-term mortality improvement rate under the SSA's intermediate-cost assumptions. The 2011 Technical Panel recommended adoption of a new mortality projection methodology that equates to an even greater (flat) long-term rate of 1.26%, but the RPEC decided that 1.0% was most appropriate for the interim Scale BB.

[September 10, 2012]

A8. What is the rationale for using the best-fit log-linear (BFLL) methodology described in Section 3.1?

Assuming that mortality rates for a given gender/age combination change at a constant rate over a given observation period, the BFLL method is a way to solve for an appropriate constant, k, in the following equation, where x represents the given age and t represents the time variable.

$$q(x, t) = (1-k)^t * q(x, 0)$$

Taking the logarithm of the above formula and rearranging terms results in the following:

$$ln(1-k) = [ln(q(x, t)) – ln(q(x, 0))] / t.$$

Note that the right-hand side above represents the slope of the line connecting $ln(q(x, 0))$ and $ln(q(x, t))$. To avoid possible distortions from the endpoints of the interval being studied, the BFLL methodology replaces this slope with s, the slope of the corresponding best- fit regression line. Hence $ln(1-k) = s$, which implies $k = 1 – e^s$.

It should be noted that this BFLL methodology was used for similar purposes in Chapter 4 of the RP-2000 Report.

[September 10, 2012]

Section B: Application of Scale BB

B1. What factors should an actuary consider when trying to decide whether to adopt Scale BB?

According to Section 3.1 of ASOP 35, an actuary "should use professional judgment to estimate possible future outcomes based on past experience and future expectations, and select assumptions based upon application of that professional judgment." Section 3.3.1 of ASOP 35 goes on to add that the actuary "should consider the assumption universe relevant to each type of assumption identified…" and that relevant sources include "studies or reports of general trends relevant to the type of demographic assumption in question (for example, mortality improvement in the United States)."

As mentioned in the answers to Q&A A1 and A2, the Scale BB report and a number of other recent studies have documented that Scale AA has not matched up well with recent mortality improvement experience in the US. Not only is the data used to develop Scale BB approximately 20 years more current than the data used to develop Scale AA, the actuarial methodology underpinning Scale BB is considerably more advanced, blending actual past mortality improvement experience with anticipated future longevity trends. Given the more up-to-date data set and the enhanced methodology, it seems reasonable to expect that actuaries will give particular credence to the findings in the Scale BB report when selecting a mortality improvement assumption.

If the group being valued is large enough, a traditional mortality experience study could be useful in comparing the effectiveness of different mortality improvement scales over the recent past. Starting with the same base mortality rates, one set of actual-to-expected (A/E) ratios could be developed with expected deaths calculated using the mortality projection scale currently assumed, and a second set of A/E ratios developed with expected deaths calculated using Scale BB. A comparison of the resulting A/E ratios could provide useful information with respect to general mortality improvement trends of the covered group over the study period.

Of course, situations exist where the differences in mortality improvement assumptions have little impact on plan obligations, and the materiality language within ASOP 35 comes into play. For example, the decision regarding possible adoption of Scale BB for a cash balance plan whose participants overwhelmingly elect lump sum distributions could fall into this category.

[May 11, 2012]

B2. How should Scale BB be applied if the base year of the mortality table is prior to 2000?

Scale BB was designed to be applied on a generational basis to calendar year 2000 mortality rates. If the base year of the mortality rates is prior to 2000, RPEC suggests first adjusting the base rates to 2000, and then applying Scale BB.

RPEC believes a reasonable approach would be to use the full set of two-dimensional mortality improvement rates (see Q&A A2 in this document) to first project mortality rates from their base year to 2000, and then apply Scale BB.

For example, suppose that the mortality table is UP-94. The UP-94 rate for a female age 60 is 0.004773. Using the complements of six factors in the female two-dimensional table found in the "age 60" row of columns 1995 through 2000, the age 60 rate for a female projected to 2000 would be calculated as follows:

$$q'^{(2000)}_{60} = 0.004773 * [(1 - 0.0096) * (1 - 0.0106) * (1 - 0.0118) * (1 - 0.0126) * (1 - 0.0129) * (1 - 0.0126)]$$

$$= 0.004773 * 0.931912$$

$$= 0.004448$$

The rate of 0.004448 above would then be projected beyond 2000 with Scale BB.

Recognizing that a number of actuaries still use tables with a 1994 base year, RPEC has calculated the projection Adjustment Factors developed as described above for the six-year period 1994 though 2000, and has included tables of these Adjustment Factors in Appendix A.

Of course, statutory reserving currently continues to be done on the basis of the GAR-94 table, which is equivalent to the GAM-94 Static table with full generational projection using Scale AA.

[May 11, 2012]

B3. How should Scale BB be applied if the base year of the mortality table is after 2000?

Scale BB can be applied without adjustment to a mortality table with base year after 2000.

Alternatively, the approach outlined in Q&A B2 (using the two-dimensional mortality improvement tables) could be used to "back out" mortality improvement between 2000 and the base year, before applying Scale BB. Note, however, that the two-dimensional rates beyond calendar year 2005 incorporate RPEC's assumptions about future mortality improvement trends; i.e., they are not based exclusively on historical SSA mortality improvement experience.

[May 11, 2012]

B4. Many retirement plans are currently valued using RP-2000 base rates projected using Scale AA. Is it appropriate to continue to project base mortality rates with Scale AA for some period of time beyond 2000 (e.g., through 2012) and then project mortality improvements using Scale BB from that point forward?

Generally, no. As noted in Q&A A1, a primary reason for RPEC's development and publication of interim Scale BB was the fact that Scale AA has not matched up well with actual US mortality improvement experience since 2000.

However, if the post-2000 mortality improvement experience for the group being valued is found to differ from that predicted by Scale BB, then it would be appropriate to reflect such experience, to the extent it is determined to be credible.

[May 11, 2012]

B5. The Supplement to the RP-2000 Mortality Table Report that was published in December 2003 included two collar-adjusted and three amount-adjusted base mortality tables with 2000 effective dates. Is it appropriate to apply Scale BB projection to those tables?

The Supplement to the RP-2000 study was silent regarding the appropriateness of applying Scale AA to project the collar- and amount-adjusted RP-2000 base tables, although some level of continued mortality improvement within these subpopulations would necessarily be expected. While there has been some recent evidence of lower rates of mortality improvement for males with low career earnings compared to males with high earnings [US Social Security Administration; ORES Working Paper No. 108, October 2007], a great deal remains unknown about potential correlations between socio-economic status and mortality improvement in the US. As part of the current Pension Plan Mortality Study, RPEC will be attempting to measure the impact of various socio-economic factors on US mortality improvement trends.

To the extent that the demographic characteristics of the group being valued are reasonably consistent with those of the Social Security population (from which Scale BB was developed), RPEC believes it would be appropriate to apply Scale BB to the corresponding collar- or amount-adjusted base table.

[May 11, 2012]

B6. Why does RPEC recommend generational mortality over static projections?

The projection of future mortality rates on a generational basis was first introduced to pension actuaries in the United States with the release of Scale AA in connection with the 1994 series of base tables. The authors of the RP-2000 Report encouraged the use of generational mortality projection over static approximations. Currently, most pension valuation systems can accommodate generational projection of mortality based on gender/age-specific mortality improvement rates, such as Scale AA and Scale BB.

A number of fundamental issues related to the use of duration-based static tables (other than the increased variability addressed in Section 7.1 of the exposure draft) have been identified since its introduction in 1994. While this technique usually works reasonably well when used to value a specific type of obligation for a given covered group, pension valuations typically involve many different types of measurements (e.g., current service cost, accumulated benefit obligation, projected benefit obligation, etc.) and often require accurate allocation of obligations among different subgroups. Each combination of measurement type and covered subgroup produces its own specific duration which, in turn, would theoretically require its own statically projected mortality table. Furthermore, each of those tables would, in theory, require annual updates to reflect the passage of one more year from the date of the base table. The use of generational projection avoids all of these issues.

Based on these considerations, RPEC believes that generational mortality improvement is the preferred method of reflecting future improvements in mortality rates, and recommends its use over static approximations.

The above notwithstanding, RPEC agrees that the use of static projections may be an adequate approximation of the generational approach in certain situations. For example, static approximations might be sufficient for certain administrative applications (e.g., specifying the basis for actuarially equivalent optional forms), for certain regulatory purposes and for the valuation of smaller retirement plan populations or plans whose primary form of benefit payment is lump sum.

[September 10, 2012]

B7. Is it appropriate for an actuary who wants to assume a higher or lower overall level of mortality improvement than that predicted by Scale BB to use some fixed percentage of Scale BB?

RPEC has not assessed the impact of using fixed percentages of Scale BB on life expectancies or annuity values. As described in Section 5 of the Exposure Draft, the development of Scale BB reflected a number of new actuarial techniques, including the blending of actual historic experience with anticipated future mortality improvement trends and the creation of age-only rates from two-dimensional tables. In light of this new methodology, the implications of using fixed percentages of Scale BB are not clear. RPEC, therefore, strongly encourages actuaries to fully understand the implications of fixed percentage loads of Scale BB before adopting such an assumption.

Q&A B8 discusses a suggested approach for users who wish to assume a different level of mortality improvement than that underpinning Scale BB.

[September 10, 2012]

B8. Can RPEC provide some examples of the suggested approach outlined in Section 7.4 for modifying the two-dimensional arrays?

The concept behind the suggested approach in Section 7.4 is to multiply all the rates in the Section 5.2 transitional arrays by a calendar-year-specific factor, *h(y).* Once the long-term rate, *L%*, and (2) an end of the post-2005 blending period, *P*, greater than 2025 have been selected, the function *h(y)* depends only on calendar year, *y*:

$$h(y) = 1.0 \qquad \text{for } y \leq 2005;$$
$$h(y) = 1.0 + (L-1) \times [(y-2005)/(P-2005)] \qquad \text{for } 2006 \leq y < P$$
$$h(y) = L \qquad \text{for } y \geq P$$

If an actuary wishes to use a long-term rate of 0.85% that is fully phased-in by 2045, then *L* = 0.85, *P* = 2045, and in this situation *h(y)* would be equal to:

$$h(y) = 1.0 \qquad \text{for } y \leq 2005;$$
$$h(y) = 1.0 - 0.15 \times [(y-2005)/40] \qquad \text{for } 2006 \leq y < 2045$$
$$h(y) = 0.85 \qquad \text{for } y \geq 2045$$

In this example, *h(2006)* = 0.99625, and consequently the modified rates for calendar year 2006 would equal 99.625% of the 2006 rates in the original Section 5.2 arrays. The following table displays some *h(y)* values produced by this particular choice assumptions and how *h(y)* is used as a multiplicative factor to modify the original two-dimensional rates in Section 5.2:

	Calendar Year, y											
	2004	**2005**	**2006**	**2007**	**…**	**2023**	**2024**	**…**	**2043**	**2044**	**2045**	**2046**
h(y)	***1.00000***	***1.00000***	***0.99625***	***0.99250***	**…**	***0.93250***	***0.92875***	**…**	***0.85750***	***0.85375***	***0.85000***	***0.85000***
Section 5.2 Female Rates At Ages 64, 65, and 66 (Unmodified)												
64	0.02140	0.02260	0.02100	0.02000	…	0.01010	0.01000	…	0.01000	0.01000	0.01000	0.01000
65	0.02330	0.02470	0.02260	0.02060	…	0.01010	0.01000	…	0.01000	0.01000	0.01000	0.01000
66	0.02430	0.02620	0.02460	0.02210	…	0.01010	0.01000	…	0.01000	0.01000	0.01000	0.01000
Section 5.2 Female Rates At Ages 64, 65, and 66 Modified per Section 7.4 Suggested Approach												
64	0.02140	0.02260	0.02092	0.01985	…	0.00942	0.00929	…	0.00858	0.00854	0.00850	0.00850
65	0.02330	0.02470	0.02252	0.02045	…	0.00942	0.00929	…	0.00858	0.00854	0.00850	0.00850
66	0.02430	0.02620	0.02451	0.02193	…	0.00942	0.00929	…	0.00858	0.00854	0.00850	0.00850

This approach can also be followed by users who wish to develop a set of mortality improvement rates assuming a long-term rate greater than 1.0%. For example, the *h(y)* formula for a user who wants to assume a long-term rate of 1.2% that is fully phased in by 2035, would be:

$$h(y) = 1.0 \qquad \text{for } y \leq 2005;$$
$$h(y) = 1.0 + 0.20 \times [(y-2005)/30] \qquad \text{for } 2006 \leq y < 2035.$$
$$h(y) = 1.2 \qquad \text{for } y \geq 2035$$

[September 10, 2012]

B9. How should Scale BB be applied when the Entry Age actuarial cost method is being used to measure obligations?

Entry Age is one of a number of cost methods that requires an assumption regarding mortality rates for periods of time prior to the measurement date, and often prior to the base year of the assumed mortality table.

For the following discussion, let B represent the base year of the underlying mortality table (for example, B = 2000 for the RP-2000 tables). RPEC believes that a reasonable approach for applying a set of mortality improvement rates would be one in which for each individual, the resulting mortality rate that gets projected from that individual's calendar year of entry, E, to B matches exactly the mortality rate in the base table at that attained age of the individual in calendar year B.

A user who wishes to apply Scale BB to the RP-2000 base table in an Entry Age environment, therefore, could develop a set of mortality rates prior to 2000 by applying the appropriate power of the reciprocal of the age-specific Scale BB factor to the base RP-2000 q at that age. Given a male who was hired at age 30 in 1988, for example, the appropriate mortality rate in 1988 would be:

$$0.000444 \times [(1 - 0.3\%) \wedge (1988 - 2000)] = 0.000460,$$

where 0.3% is the Scale BB mortality improvement rate for males at age 30 and 0.000444 is the RP-2000 mortality rate for male Employees at age 30.

This approach represents, in essence, the reverse process followed in the typical (prospective) application of Scale BB. Instead of using the Scale BB rates to project from one year to the next **beyond** the base rates, this technique uses the reciprocal of the Scale BB factors to extend base mortality rates backwards to years **prior** to the base year.

This technique can also be used with the two-dimensional improvement scales that vary by age and calendar year described in Q&A A3 above. In that case, the retrospective application of the two-dimensional rates would be accomplished using a parallel approach to that described in the first part of this answer, but applying the methodology described in Q&A C3 rather than that of Q&A C2.

Some users might find it necessary to develop mortality rates for calendar years prior to 1950, the earliest year for which two-dimensional mortality improvement rates were developed for this project. According to The Long-Range Demographic Assumptions For the 2012 Trustees Report (Office of the Chief Actuary, SSA, April 2012), between calendar years 1900 and 1954 the average reduction in central death rates for ages 15 - 49 was approximately 2.2% for males and 3.1% for females. Consequently, RPEC believes that for entry-age-type valuation purposes, it would not be unreasonable for users to assume flat mortality improvement rates of 2.0% per annum for males and 3.0% per annum for females for all calendar years prior to 1950.

[April 8, 2013]

B10. What is the applicability of Scale BB to projections of mortality for individual annuities and group annuities?

RPEC is authorized by the SOA's Board of Directors to provide its professional opinion on retirement plans only. The SOA's Individual Annuity Experience Committee and Group Annuity Experience Committee provide opinions for other annuity lines of business.

[September 10, 2012]

Section C: Two-Dimensional Mortality Improvement Scales

C1. Why is RPEC considering mortality improvement scales that vary by factors other than gender and age?

In its investigation of recent US mortality improvement trends, RPEC had at its disposal more advanced tools than were available to the developers of previous mortality improvement scales. Some of the tools, such as those that produced the two-dimensional heat maps (see Figures 3(M) and 3(F) in the Exposure Draft), helped RPEC identify long-term US mortality improvement trends that previously had for the most part gone unnoticed. For example, "period" effects show up as strong vertical patterns, while year-of-birth "cohort" effects show up as diagonal patterns in the heat maps. Interestingly, "age" effects -- which would show up as purely horizontal patterns -- are generally absent from Figures 3(M) and 3(F). This implies that age alone does not seem like a very effective way to project long term mortality improvement in the US.

New mortality improvement methodologies, such as the model developed by the Continuous Mortality Investigation Bureau in the UK, not only allow for the recognition of recent age/period and cohort effects, but also allow for the blending of these effects into a long-term expected rate of mortality improvement. In other words, the mortality improvement scale is not just projecting past trends into the future but also allows for an expectation of the level of future long term mortality improvement.

For these reasons, the RPEC is seriously considering two dimensional mortality improvement tables as the standard for future pension related mortality improvement scales.

[May 11, 2012]

C2. How do you develop generational mortality rates using the gender-specific improvement Scale BB, which varies by age?

In order to develop a generational mortality table, you will need a table of age-specific mortality rates that are applicable as of a particular 'base' year and a 'rule' to project those 'base' mortality rates into future years beyond the 'base' year. The result of applying the 'rule' to the 'base' mortality table will be a two-dimensional mortality table that varies by age and calendar year.

Year / Age	2000	2001	2002	2003	…
1	q_1^{2000}	q'^{2001}_1	q'^{2002}_1	q'^{2003}_1	…
2	q_2^{2000}	q'^{2001}_2	q'^{2002}_2	q'^{2003}_2	…
3	q_3^{2000}	q'^{2001}_3	q'^{2002}_3	q'^{2003}_3	…
4	q_4^{2000}	q'^{2001}_4	q'^{2002}_4	q'^{2003}_4	…
5	q_5^{2000}	q'^{2001}_5	q'^{2002}_5	q'^{2003}_5	…
6	q_6^{2000}	q'^{2001}_6	q'^{2002}_6	q'^{2003}_6	…
…	…	…	…	…	…

If the rule to project the base rates involves using an improvement scale like Scale BB that varies by age only, the generational mortality rate (q'^{y+n}_x) for a person age x in year $y+n$ would be determined by the following formula:

$$q'^{y+n}_x = q_x^y \times (1 - BB_x)^n$$

where,

BB_x is the annual rate of mortality improvement from Scale BB for age x
q_x^y is the mortality rate at age x from a base mortality table as of year y.

The following table illustrates the development of generational mortality rates q'^{2000+n}_x using RP-2000 (male, combined healthy) and Scale BB.

x	q_x^{2000}	$\times(1-BB_x)$	$= q'^{2001}_x$	$\times(1-BB_x)$	$= q'^{2002}_x$	$\times(1-BB_x)$	$= q'^{2003}_x$
65	0.012737	1-0.012	0.012584	1-0.012	0.012433	1-0.012	0.012284
66	0.014409	1-0.013	0.014222	1-0.013	0.014037	1-0.013	0.013854
67	0.016075	1-0.014	0.015850	1-0.014	0.015628	1-0.014	0.015409
…	…	…	…	…	…	…	…
120	1.000000	1-.0000	1.000000	1-.0000	1.000000	1-.0000	1.000000

x	q'^{2012}_x	$\times(1-BB_x)$	$= q'^{2013}_x$	$\times(1-BB_x)$	$= q'^{2014}_x$	…	q'^{2067}_x
65	0.011019	1-0.012	0.010887	1-0.012	0.010756	…	0.005673
66	0.012315	1-0.013	0.012155	1-0.013	0.011997	…	0.005996
67	0.013573	1-0.014	0.013383	1-0.014	0.013196	…	0.006250
…	…	…	…	…	…	…	…
120	1.000000	1-.0000	1.000000	1-.0000	1.000000	…	1.000000

The highlighted cells above contain the mortality rates that would be used in a valuation as of 2012 for a male, age 65.

[May 11, 2012]

C3. How do you develop generational mortality rates using a gender specific, two-dimensional improvement scale that varies by age and calendar year?

As in the Q&A C2, you will need a table of age-specific mortality rates that are applicable as of a particular 'base' year and a 'rule' to project those 'base' mortality rates into future years beyond the 'base' year. Also, like the prior question, the result of applying the 'rule' to the 'base' mortality table will be a two dimensional mortality table that varies by age and calendar year.

Year / Age	2000	2001	2002	2003	…
1	q_1^{2000}	q'^{2001}_1	q'^{2002}_1	q'^{2003}_1	…
2	q_2^{2000}	q'^{2001}_2	q'^{2002}_2	q'^{2003}_2	…
3	q_3^{2000}	q'^{2001}_3	q'^{2002}_3	q'^{2003}_3	…
4	q_4^{2000}	q'^{2001}_4	q'^{2002}_4	q'^{2003}_4	…
5	q_5^{2000}	q'^{2001}_5	q'^{2002}_5	q'^{2003}_5	…
6	q_6^{2000}	q'^{2001}_6	q'^{2002}_6	q'^{2003}_6	…
…	…	…	…	…	…

The 'rule' to project the base rates using a two dimensional improvement scale is similar to the rule for a scale that varies by age only. For example, with both scales, if you want 12 years of improvement, you multiply 12 improvement factors together. However, the factors will differ in complexity between the two types of scales. For the age only scale, the factors happen to be the same; i.e., $(1-BB_x)^{12}$. For the two dimensional scale, 12 ***different*** factors are multiplied together.

The formula to calculate the generational mortality rate (q'^{y+n}_x) for a person age x in year $y + n$ using a two-dimensional improvement scale that varies by age and calendar year is:

$$q'^{y+n}_x = q^y_x \times \left[\prod_{z=1}^{n}(1 - f_{x,y+z})\right]$$

where,

- $f_{x,y}$ is the annual rate of mortality improvement from the two-dimensional improvement scale for age x and in year y
- q^y_x is the mortality rate at age x from a base mortality table as of year y.

The following table illustrates the development of generational mortality rates q'^{2000+n}_x using RP-2000 (male, combined healthy) and the two-dimensional improvement rates, $f_{x,y}$, referenced in Q&A A3.

x	q^{2000}_x	$\times(1 - f_{x,2001})$	$= q'^{2001}_x$	$\times(1 - f_{x,2002})$	$= q'^{2002}_x$	$\times(1 - f_{x,2003})$	$= q'^{2003}_x$
65	0.012737	1-0.0261	0.012405	1-0.0242	0.012104	1-0.0230	0.011826
66	0.014409	1-0.0275	0.014013	1-0.0269	0.013636	1-0.0255	0.013288
67	0.016075	1-0.0274	0.015635	1-0.0281	0.015195	1-0.0278	0.014773
…	…	…	…	…	…	…	…
120	1.000000	1-0.0000	1.000000	1-0.0000	1.000000	1-0.0000	1.000000

x	q'^{2012}_x	$\times(1 - f_{x,2013})$	$= q'^{2013}_x$	$\times(1 - f_{x,2014})$	$= q'^{2014}_x$	…	q'^{2067}_x
65	0.010043	1-0.0119	0.009923	1-0.0118	0.009806	**…**	0.005711
66	0.011169	1-0.0125	0.011029	1-0.0121	0.010896	**…**	0.006345
67	0.012293	1-0.0128	0.012135	1-0.0122	0.011987	**…**	0.006980
…	…	…	…	…	…	**…**	…
120	1.000000	1-0.0000	1.000000	1-0.0000	1.000000	**…**	1.000000

The highlighted cells above contain the mortality rates that would be used in a valuation as of 2012 for a male, age 65.

[May 11, 2012]

Section D: Annuity Impact of Moving to Scale BB

D1. The Exposure Draft presented cost estimates of switching from Scale AA to Scale BB when both are applied to RP-2000 Combined Healthy base rates on a generational basis. What are the annuity value implications if Scale AA is not currently being applied on a fully generational basis?

If Scale AA is not currently being applied on a fully generational basis, annuity values will likely increase more than the levels shown in Section 6.2 of the Scale BB Exposure Draft. In general, the less projection reflected in current calculations, the greater the increase will be. A rough way to estimate the change to Scale BB would be to determine the difference between the annuity values determined using: 1) the current basis, and 2) a generational projection using Scale AA, and to add the compound this difference with the results shown in the Scale BB report.

For a plan that currently assumes little or no mortality projection, or that uses an outdated base mortality table, the increase in annuity values would be more significant.

[May 11, 2012]

D2. How sensitive were the cost estimates in Section 6 of the Exposure Draft to the assumption of a 1.0% long-term rate of mortality improvement?

The sensitivity of annuity values to the long-term rate depends on a variety of factors, including the other parameters of the underlying model and the demographic profile of the plan population. In general, RPEC found that a 0.25% increase in the long-term rate of mortality improvement caused annuity values to increase between 0.25% and 0.5%, assuming a 6% discount rate. Sensitivity is slightly higher for females than for males, and slightly higher for younger participants.

[May 11, 2012]

D3. How do annuity values compare using Scale AA, Scale BB and the full set of two-dimensional rates?

RPEC prepared the following table of 2013 annuity factors (payable monthly at the beginning of each month) based on interest of 5.0% per annum and RP-2000 Combined Healthy, projected generationally using each of Scale AA, Scale BB and the full set of two-dimensional rates from Q&A A3.

2013 Deferred-to-age-62 Annuity Values

	Scale AA		Scale BB				Scale 2D			
	Male	Female	Male	Δ from AA	Female	Δ from AA	Male	Δ from AA	Female	Δ from AA
25	2.187	2.199	2.217	1.4%	2.334	6.1%	2.211	1.1%	2.349	6.8%
35	3.494	3.543	3.541	1.3%	3.738	5.5%	3.538	1.2%	3.763	6.2%
45	5.599	5.725	5.676	1.4%	6.004	4.9%	5.680	1.5%	6.044	5.6%
55	9.031	9.333	9.182	1.7%	9.721	4.2%	9.225	2.1%	9.804	5.0%

2013 Immediate Annuity Values

	Scale AA		Scale BB				Scale 2D			
	Male	Female	Male	Δ from AA	Female	Δ from AA	Male	Δ from AA	Female	Δ from AA
50	16.088	16.299	16.161	0.5%	16.623	2.0%	16.182	0.6%	16.682	2.3%
55	14.905	15.215	15.042	0.9%	15.605	2.6%	15.089	1.2%	15.691	3.1%
60	13.496	13.938	13.711	1.6%	14.368	3.1%	13.794	2.2%	14.481	3.9%
65	11.898	12.495	12.181	2.4%	12.935	3.5%	12.306	3.4%	13.074	4.6%
70	10.166	10.927	10.486	3.1%	11.354	3.9%	10.642	4.7%	11.491	5.2%
75	8.308	9.257	8.679	4.5%	9.666	4.4%	8.833	6.3%	9.784	5.7%
80	6.463	7.525	6.865	6.2%	7.920	5.3%	6.996	8.2%	8.017	6.5%
85	4.822	5.824	5.161	7.0%	6.195	6.4%	5.270	9.3%	6.267	7.6%
90	3.500	4.412	3.713	6.1%	4.671	5.9%	3.829	9.4%	4.764	8.0%

[February 27, 2013]

APPENDIX A

Factors to Adjust Mortality Tables with 1994 Base Year to 2000

Males

	Two-Dimensional Improvement Rates: Males						Adjustment
Age	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Factor***
20	0.0244	0.0281	0.0297	0.0289	0.0254	0.0193	0.8539
21	0.0249	0.0271	0.0265	0.0233	0.0188	0.0131	0.8735
22	0.0259	0.0275	0.0261	0.0217	0.0149	0.0079	0.8821
23	0.0288	0.0283	0.0257	0.0209	0.0140	0.0055	0.8828
24	0.0352	0.0330	0.0273	0.0204	0.0128	0.0046	0.8736
25	0.0418	0.0405	0.0340	0.0234	0.0128	0.0033	0.8534
26	0.0468	0.0468	0.0417	0.0314	0.0171	0.0043	0.8254
27	0.0530	0.0520	0.0468	0.0379	0.0249	0.0093	0.7953
28	0.0614	0.0610	0.0533	0.0428	0.0304	0.0161	0.7619
29	0.0658	0.0704	0.0649	0.0510	0.0358	0.0210	0.7275
30	0.0618	0.0725	0.0730	0.0632	0.0450	0.0270	0.7022
31	0.0547	0.0669	0.0716	0.0678	0.0552	0.0357	0.6955
32	0.0548	0.0630	0.0666	0.0646	0.0568	0.0431	0.6979
33	0.0565	0.0650	0.0665	0.0617	0.0537	0.0430	0.6998
34	0.0525	0.0642	0.0679	0.0637	0.0530	0.0412	0.7026
35	0.0458	0.0570	0.0626	0.0616	0.0541	0.0414	0.7177
36	0.0463	0.0529	0.0552	0.0538	0.0488	0.0402	0.7372
37	0.0485	0.0554	0.0551	0.0488	0.0411	0.0333	0.7488
38	0.0445	0.0552	0.0576	0.0517	0.0392	0.0277	0.7537
39	0.0354	0.0473	0.0530	0.0513	0.0425	0.0281	0.7683
40	0.0315	0.0397	0.0441	0.0441	0.0394	0.0300	0.7919
41	0.0291	0.0375	0.0399	0.0369	0.0318	0.0253	0.8155
42	0.0218	0.0337	0.0383	0.0359	0.0278	0.0197	0.8352
43	0.0114	0.0239	0.0316	0.0330	0.0282	0.0187	0.8617
44	0.0088	0.0153	0.0216	0.0246	0.0236	0.0186	0.8926
45	0.0113	0.0144	0.0160	0.0162	0.0151	0.0128	0.9172
46	0.0129	0.0156	0.0158	0.0134	0.0092	0.0056	0.9296
47	0.0135	0.0149	0.0145	0.0120	0.0076	0.0018	0.9373
48	0.0176	0.0166	0.0133	0.0093	0.0048	-0.0001	0.9399
49	0.0223	0.0221	0.0176	0.0096	0.0022	-0.0035	0.9315
50	0.0227	0.0259	0.0238	0.0163	0.0049	-0.0046	0.9139
51	0.0185	0.0241	0.0257	0.0220	0.0131	0.0004	0.9004
52	0.0172	0.0200	0.0230	0.0227	0.0180	0.0088	0.8951
53	0.0189	0.0195	0.0202	0.0206	0.0184	0.0132	0.8942
54	0.0206	0.0207	0.0203	0.0194	0.0177	0.0144	0.8921
55	0.0212	0.0212	0.0207	0.0196	0.0178	0.0153	0.8896
56	0.0221	0.0217	0.0207	0.0194	0.0178	0.0158	0.8881
57	0.0231	0.0229	0.0216	0.0195	0.0174	0.0156	0.8857
58	0.0229	0.0236	0.0230	0.0210	0.0180	0.0155	0.8822
59	0.0218	0.0230	0.0233	0.0222	0.0199	0.0167	0.8796
60	0.0219	0.0225	0.0228	0.0224	0.0210	0.0187	0.8775
61	0.0223	0.0232	0.0233	0.0226	0.0214	0.0198	0.8745
62	0.0210	0.0234	0.0244	0.0240	0.0224	0.0208	0.8715
63	0.0179	0.0217	0.0243	0.0253	0.0247	0.0227	0.8709
64	0.0159	0.0187	0.0225	0.0252	0.0261	0.0254	0.8734
65	0.0151	0.0170	0.0200	0.0235	0.0260	0.0268	0.8782
66	0.0140	0.0161	0.0186	0.0216	0.0246	0.0267	0.8843
67	0.0119	0.0147	0.0177	0.0206	0.0233	0.0258	0.8912
68	0.0103	0.0124	0.0162	0.0197	0.0227	0.0251	0.8981
69	0.0096	0.0107	0.0137	0.0180	0.0219	0.0248	0.9052

* See Q&A B2 for description of the Adjustment Factor

Factors to Adjust Mortality Tables with 1994 Base Year to 2000

Males

	Two-Dimensional Improvement Rates: Males						**Adjustment**
Age	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Factor***
70	0.0095	0.0099	0.0118	0.0154	0.0200	0.0239	0.9128
71	0.0097	0.0097	0.0109	0.0135	0.0173	0.0220	0.9197
72	0.0102	0.0099	0.0107	0.0126	0.0154	0.0193	0.9244
73	0.0110	0.0104	0.0109	0.0123	0.0145	0.0175	0.9258
74	0.0115	0.0111	0.0114	0.0125	0.0143	0.0167	0.9249
75	0.0113	0.0112	0.0117	0.0128	0.0143	0.0163	0.9249
76	0.0110	0.0109	0.0117	0.0130	0.0145	0.0162	0.9251
77	0.0109	0.0106	0.0113	0.0129	0.0146	0.0164	0.9257
78	0.0103	0.0103	0.0111	0.0125	0.0145	0.0164	0.9272
79	0.0088	0.0095	0.0107	0.0123	0.0142	0.0163	0.9303
80	0.0070	0.0077	0.0097	0.0119	0.0141	0.0162	0.9352
81	0.0054	0.0057	0.0075	0.0106	0.0135	0.0161	0.9426
82	0.0041	0.0040	0.0053	0.0081	0.0120	0.0155	0.9519
83	0.0028	0.0027	0.0037	0.0060	0.0095	0.0139	0.9620
84	0.0015	0.0014	0.0024	0.0043	0.0073	0.0113	0.9721
85	0.0002	0.0001	0.0010	0.0029	0.0057	0.0091	0.9811
86	-0.0014	-0.0014	-0.0005	0.0014	0.0041	0.0073	0.9905
87	-0.0031	-0.0030	-0.0020	-0.0002	0.0024	0.0056	1.0003
88	-0.0045	-0.0046	-0.0036	-0.0018	0.0007	0.0038	1.0100
89	-0.0052	-0.0058	-0.0052	-0.0034	-0.0010	0.0020	1.0187
90	-0.0057	-0.0066	-0.0064	-0.0051	-0.0027	0.0002	1.0266
91	-0.0068	-0.0075	-0.0073	-0.0063	-0.0043	-0.0016	1.0343
92	-0.0083	-0.0090	-0.0085	-0.0074	-0.0055	-0.0031	1.0425
93	-0.0090	-0.0104	-0.0102	-0.0088	-0.0067	-0.0043	1.0504
94	-0.0086	-0.0108	-0.0114	-0.0105	-0.0082	-0.0056	1.0564
95	-0.0081	-0.0104	-0.0116	-0.0114	-0.0098	-0.0070	1.0597
96	-0.0090	-0.0104	-0.0114	-0.0115	-0.0104	-0.0082	1.0625
97	-0.0098	-0.0115	-0.0121	-0.0117	-0.0106	-0.0087	1.0661
98	-0.0089	-0.0117	-0.0130	-0.0127	-0.0112	-0.0090	1.0684
99	-0.0063	-0.0100	-0.0124	-0.0131	-0.0122	-0.0098	1.0655
100	-0.0051	-0.0074	-0.0104	-0.0121	-0.0122	-0.0106	1.0592
101	-0.0041	-0.0064	-0.0094	-0.0111	-0.0112	-0.0096	1.0529
102	-0.0031	-0.0054	-0.0084	-0.0101	-0.0102	-0.0086	1.0467
103	-0.0021	-0.0044	-0.0074	-0.0091	-0.0092	-0.0076	1.0404
104	-0.0011	-0.0034	-0.0064	-0.0081	-0.0082	-0.0066	1.0343
105	-0.0001	-0.0024	-0.0054	-0.0071	-0.0072	-0.0056	1.0281
106	0.0000	-0.0014	-0.0044	-0.0061	-0.0062	-0.0046	1.0229
107	0.0000	-0.0004	-0.0034	-0.0051	-0.0052	-0.0036	1.0178
108	0.0000	0.0000	-0.0024	-0.0041	-0.0042	-0.0026	1.0134
109	0.0000	0.0000	-0.0014	-0.0031	-0.0032	-0.0016	1.0093
110	0.0000	0.0000	-0.0004	-0.0021	-0.0022	-0.0006	1.0053
111	0.0000	0.0000	0.0000	-0.0011	-0.0012	0.0000	1.0023
112	0.0000	0.0000	0.0000	-0.0001	-0.0002	0.0000	1.0003
113	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
114	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
115	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
116	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
117	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
118	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
119	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000

* See Q&A B2 for description of the Adjustment Factor

APPENDIX A – cont'd

Factors to Adjust Mortality Tables with 1994 Base Year to 2000

Females

	Two-Dimensional Improvement Rates: Females						Adjustment
Age	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Factor***
20	0.0152	0.0138	0.0112	0.0084	0.0059	0.0036	0.9432
21	0.0153	0.0139	0.0110	0.0070	0.0033	0.0003	0.9502
22	0.0164	0.0146	0.0116	0.0074	0.0024	-0.0018	0.9503
23	0.0192	0.0165	0.0129	0.0085	0.0034	-0.0021	0.9428
24	0.0229	0.0204	0.0157	0.0104	0.0050	-0.0007	0.9283
25	0.0253	0.0245	0.0205	0.0140	0.0074	0.0013	0.9103
26	0.0253	0.0265	0.0245	0.0193	0.0114	0.0040	0.8938
27	0.0240	0.0264	0.0260	0.0228	0.0165	0.0080	0.8824
28	0.0239	0.0260	0.0261	0.0240	0.0196	0.0128	0.8746
29	0.0234	0.0263	0.0267	0.0247	0.0210	0.0157	0.8698
30	0.0210	0.0254	0.0269	0.0257	0.0220	0.0172	0.8695
31	0.0173	0.0223	0.0251	0.0253	0.0229	0.0183	0.8757
32	0.0150	0.0190	0.0220	0.0231	0.0222	0.0191	0.8855
33	0.0133	0.0170	0.0194	0.0205	0.0202	0.0184	0.8960
34	0.0107	0.0146	0.0170	0.0181	0.0180	0.0168	0.9085
35	0.0077	0.0110	0.0134	0.0148	0.0152	0.0148	0.9255
36	0.0060	0.0084	0.0096	0.0104	0.0110	0.0115	0.9444
37	0.0040	0.0068	0.0077	0.0071	0.0067	0.0070	0.9613
38	0.0002	0.0041	0.0059	0.0058	0.0042	0.0033	0.9767
39	-0.0039	-0.0004	0.0021	0.0031	0.0027	0.0014	0.9950
40	-0.0052	-0.0038	-0.0024	-0.0014	-0.0008	-0.0007	1.0144
41	-0.0048	-0.0044	-0.0045	-0.0051	-0.0052	-0.0047	1.0290
42	-0.0044	-0.0042	-0.0048	-0.0062	-0.0079	-0.0084	1.0364
43	-0.0032	-0.0042	-0.0053	-0.0067	-0.0085	-0.0102	1.0387
44	0.0006	-0.0020	-0.0049	-0.0075	-0.0095	-0.0110	1.0347
45	0.0052	0.0025	-0.0015	-0.0064	-0.0101	-0.0123	1.0227
46	0.0082	0.0065	0.0031	-0.0019	-0.0080	-0.0124	1.0043
47	0.0099	0.0086	0.0061	0.0021	-0.0034	-0.0097	0.9863
48	0.0127	0.0111	0.0082	0.0045	-0.0001	-0.0054	0.9693
49	0.0153	0.0145	0.0117	0.0072	0.0024	-0.0023	0.9521
50	0.0155	0.0167	0.0154	0.0117	0.0061	0.0007	0.9356
51	0.0129	0.0156	0.0165	0.0150	0.0110	0.0052	0.9261
52	0.0116	0.0128	0.0149	0.0154	0.0139	0.0102	0.9237
53	0.0120	0.0117	0.0125	0.0139	0.0142	0.0127	0.9254
54	0.0131	0.0119	0.0115	0.0121	0.0132	0.0134	0.9271
55	0.0142	0.0125	0.0113	0.0111	0.0118	0.0132	0.9281
56	0.0146	0.0134	0.0116	0.0106	0.0106	0.0119	0.9295
57	0.0141	0.0140	0.0127	0.0109	0.0100	0.0105	0.9299
58	0.0128	0.0136	0.0134	0.0123	0.0106	0.0101	0.9294
59	0.0108	0.0122	0.0130	0.0130	0.0122	0.0110	0.9299
60	0.0096	0.0106	0.0118	0.0126	0.0129	0.0126	0.9319
61	0.0086	0.0095	0.0106	0.0118	0.0128	0.0134	0.9351
62	0.0074	0.0086	0.0098	0.0112	0.0126	0.0138	0.9382
63	0.0056	0.0071	0.0088	0.0106	0.0124	0.0142	0.9427
64	0.0039	0.0051	0.0072	0.0095	0.0119	0.0142	0.9493
65	0.0025	0.0033	0.0051	0.0078	0.0107	0.0136	0.9577
66	0.0011	0.0018	0.0034	0.0059	0.0092	0.0125	0.9665
67	0.0000	0.0007	0.0022	0.0045	0.0076	0.0112	0.9740
68	-0.0002	-0.0001	0.0014	0.0036	0.0064	0.0098	0.9792
69	0.0000	-0.0002	0.0009	0.0030	0.0057	0.0088	0.9819

* See Q&A B2 for description of the Adjustment Factor

Factors to Adjust Mortality Tables with 1994 Base Year to 2000

Females

	Two-Dimensional Improvement Rates: Females						Adjustment
Age	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Factor***
70	-0.0003	-0.0004	0.0005	0.0024	0.0052	0.0082	0.9845
71	-0.0007	-0.0008	0.0000	0.0017	0.0042	0.0076	0.9880
72	-0.0002	-0.0008	-0.0004	0.0010	0.0032	0.0063	0.9909
73	0.0007	-0.0001	-0.0001	0.0009	0.0027	0.0053	0.9906
74	0.0008	0.0002	0.0004	0.0013	0.0029	0.0051	0.9893
75	0.0000	-0.0004	0.0000	0.0011	0.0029	0.0053	0.9911
76	-0.0004	-0.0011	-0.0009	0.0002	0.0021	0.0048	0.9953
77	-0.0003	-0.0012	-0.0013	-0.0005	0.0011	0.0037	0.9985
78	-0.0010	-0.0016	-0.0014	-0.0006	0.0010	0.0032	1.0004
79	-0.0025	-0.0029	-0.0024	-0.0011	0.0009	0.0035	1.0045
80	-0.0038	-0.0046	-0.0040	-0.0025	-0.0001	0.0030	1.0120
81	-0.0043	-0.0057	-0.0056	-0.0041	-0.0017	0.0016	1.0199
82	-0.0047	-0.0063	-0.0066	-0.0054	-0.0029	0.0004	1.0258
83	-0.0054	-0.0071	-0.0075	-0.0064	-0.0039	-0.0002	1.0309
84	-0.0062	-0.0079	-0.0084	-0.0075	-0.0051	-0.0014	1.0370
85	-0.0066	-0.0087	-0.0093	-0.0085	-0.0063	-0.0029	1.0430
86	-0.0071	-0.0093	-0.0100	-0.0092	-0.0071	-0.0039	1.0475
87	-0.0082	-0.0101	-0.0106	-0.0098	-0.0076	-0.0043	1.0517
88	-0.0097	-0.0116	-0.0117	-0.0106	-0.0083	-0.0049	1.0581
89	-0.0103	-0.0130	-0.0134	-0.0119	-0.0093	-0.0058	1.0654
90	-0.0101	-0.0134	-0.0145	-0.0134	-0.0104	-0.0066	1.0704
91	-0.0103	-0.0133	-0.0146	-0.0140	-0.0114	-0.0074	1.0731
92	-0.0120	-0.0144	-0.0150	-0.0140	-0.0117	-0.0080	1.0775
93	-0.0129	-0.0162	-0.0168	-0.0149	-0.0120	-0.0083	1.0839
94	-0.0117	-0.0164	-0.0182	-0.0169	-0.0131	-0.0088	1.0881
95	-0.0102	-0.0150	-0.0175	-0.0174	-0.0146	-0.0097	1.0874
96	-0.0115	-0.0148	-0.0166	-0.0165	-0.0145	-0.0105	1.0874
97	-0.0129	-0.0167	-0.0178	-0.0165	-0.0138	-0.0102	1.0912
98	-0.0115	-0.0174	-0.0198	-0.0187	-0.0147	-0.0101	1.0958
99	-0.0079	-0.0150	-0.0194	-0.0201	-0.0172	-0.0114	1.0945
100	-0.0069	-0.0122	-0.0171	-0.0193	-0.0182	-0.0140	1.0909
101	-0.0059	-0.0112	-0.0161	-0.0183	-0.0172	-0.0130	1.0845
102	-0.0049	-0.0102	-0.0151	-0.0173	-0.0162	-0.0120	1.0781
103	-0.0039	-0.0092	-0.0141	-0.0163	-0.0152	-0.0110	1.0717
104	-0.0029	-0.0082	-0.0131	-0.0153	-0.0142	-0.0100	1.0654
105	-0.0019	-0.0072	-0.0121	-0.0143	-0.0132	-0.0090	1.0590
106	-0.0009	-0.0062	-0.0111	-0.0133	-0.0122	-0.0080	1.0528
107	0.0000	-0.0052	-0.0101	-0.0123	-0.0112	-0.0070	1.0466
108	0.0000	-0.0042	-0.0091	-0.0113	-0.0102	-0.0060	1.0415
109	0.0000	-0.0032	-0.0081	-0.0103	-0.0092	-0.0050	1.0363
110	0.0000	-0.0022	-0.0071	-0.0093	-0.0082	-0.0040	1.0312
111	0.0000	-0.0012	-0.0061	-0.0083	-0.0072	-0.0030	1.0260
112	0.0000	-0.0002	-0.0051	-0.0073	-0.0062	-0.0020	1.0210
113	0.0000	0.0000	-0.0041	-0.0063	-0.0052	-0.0010	1.0167
114	0.0000	0.0000	-0.0031	-0.0053	-0.0042	0.0000	1.0127
115	0.0000	0.0000	-0.0021	-0.0043	-0.0032	0.0000	1.0096
116	0.0000	0.0000	-0.0011	-0.0033	-0.0022	0.0000	1.0066
117	0.0000	0.0000	-0.0001	-0.0023	-0.0012	0.0000	1.0036
118	0.0000	0.0000	0.0000	-0.0013	-0.0002	0.0000	1.0015
119	0.0000	0.0000	0.0000	-0.0003	0.0000	0.0000	1.0003
120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000

* See Q&A B2 for description of the Adjustment Factor