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Room 5203

Internal Revenue Service

PO Box 7604

Ben Franklin Station

Washington, D.C. 20044

<http://www.regulations.gov> (IRS REG-112324-15)

Re: Mortality Tables for Determining Present Value for Defined Benefit Pension Plans

To Whom It May Concern:

The Pension Committee of the American Academy of Actuaries¹ respectfully asks for your consideration of our comments regarding the proposal to update mortality tables under §430(h)(3) (and by extension §§417(e) and 415) of the Internal Revenue Code for 2018 and later plan years. We appreciate the significant time commitment by the IRS to develop its proposal and balance the appropriateness of the proposed mortality tables for their intended usage with both flexibility and ease of use for plan sponsors and administrators.

Baseline Generational Mortality Assumption Proposal

As noted in our February 5, 2015, letter² offering comments on the development of the updated §430 mortality tables, we believe that pension plans should be using up-to-date mortality assumptions and best practices where possible. The experience study table as of 2006 underlying the RP-2014 Total Dataset mortality table published by the Society of Actuaries was developed primarily to serve as a replacement to RP-2000 for private sector defined benefit plan funding purposes, and we believe it is the most appropriate base table option available for the typical pension plan. We also noted in our prior comments that the RPEC_2014 model, which takes into consideration both period and cohort effects for future mortality improvement, is a reasonable framework for developing a projection of mortality improvement, and we continue our support of this model in the proposed regulations. The more recent updates to inputs for the model and resulting scale (e.g., the MP-2016 table proposed by Treasury for §430 purposes) reflect an improvement over the original MP-2014 scale. The inclusion

¹ The American Academy of Actuaries is a 19,000-member professional association whose mission is to serve the public and the U.S. actuarial profession. For more than 50 years, the Academy has assisted public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

² http://www.actuary.org/files/IRS_Funding_and_417_Mortality_Comment_Letter_02052015.pdf

of the most recently available U.S. mortality data, as well as changes to the “committee-selected” assumptions, make progress toward addressing our concerns about reflecting the emerging mortality levels and trends and reducing potential volatility inherent in the original MP-2014 methodology. However, there are still varying opinions among experts regarding the ultimate long-term mortality improvement rate, how best to transition from historical data to the long-term assumption, and how to better manage the volatility that can occur when introducing new data to the model. In general, we support the use of MP-2016 as the mortality improvement scale for the 2018 plan year generally applicable mortality tables. The proposed regulations note an expectation that further updates will be reflected as they become available, and we strongly support this. We encourage IRS and Treasury to remain abreast of developments in this area beyond the studies and periodic updates prepared by RPEC, and to be open to considering comprehensively different, newly developed models that may become available.

The proposed regulations do not address mortality for disabled participants. The proposed regulations state that guidance on mortality tables that may be used for disabled lives will be published through guidance in the Internal Revenue Bulletin. Presumably such guidance would be published separately from this regulation and thus will not be subject to a comment period. In the meantime, existing guidance continues to permit use of a special disabled life table for pre-1995 disabled participants. We believe that a separate table for pre-1995 disabled participants is no longer necessary, as the liability attributable to participants who became disabled more than 20 years ago is small and will further decline over time. Instead, the table applicable to post-1994 disableds could reasonably be applied to anyone remaining in this earlier group. For participants disabled after 1994, the statute restricts the use of a separate table to those who are eligible for Social Security disability benefits. The RP-2014 study included Disabled Retiree tables based on a population that reflected a variety of eligibility criteria to receive disability benefits.³ This table therefore may not be a suitable table under §430(h)(3)(D)(ii). We suggest that an up-to-date table that is more specific to that definition, such as the table used by the Social Security Administration, would be more appropriate than the RP-2014 Disabled Retiree table.

Derivation of Static Tables From Proposed Generational Mortality Basis

The proposed regulations provide for the continued use of static alternatives to the generational improvement. As noted in our 2015 comment letter, the pension actuarial community has gradually moved toward a generational basis for mortality improvement over the past 20 years since the introduction of the 1994 tables. However, we acknowledge that for certain purposes such as administration and for the valuation of smaller plans, requiring generational projection may introduce more complication and reprogramming cost than is appropriate for the associated refinement of the result.

The proposed methodology for simplification from the generational to the static basis is arithmetically more precise than the previous regulations’ approach due to its sliding years of projection based on the age of the participant. This approach allows the simplification to be more closely aligned with the underlying generational basis across multiple plans and demographic compositions.

³ The types of eligibility criteria cited in the RP-2014 report include Social Security award, own occupation (with either lifetime or limited period duration), and any occupation (with either lifetime or limited period duration).

In our mathematical review of the proposed methodology, we were most closely able to align overall results for a typical plan based on the static and generational mortality approaches using an interest rate around 6.0 percent. While the immediate annuity factors aligned reasonably well at alternative interest rates, the deferred factors diverged rather significantly, with the deferred annuity factors producing lower liabilities than if the generational approach is applied. The result is a poor overall match to the liabilities calculated using the generational basis, particularly at lower interest rates.

Current stabilized interest rates used for §430 valuations under the Bipartisan Budget Act of 2015 (BBA), which are based on a historical 25-year average of interest rates, produce effective interest rates for most plans in the 5.75 percent to 6.0 percent range. However, current market interest rates remain well below the historical 25-year average. Consequently, it is expected that the minimum funding rates will decline in the future (barring a significant change in the economic environment) as these low rates are averaged in and higher rates from 25 years ago drop out. Furthermore, current law as amended by the BBA would begin to expand the corridor around the 25-year average beginning in 2021—more significantly depressing interest rates used for valuations after the phase-out begins.

Moreover, the same mortality table is used for certain calculations that use a two-year or shorter average discount rate (such as maximum tax-deductible, ERISA §4010 gateway, and PBGC premium determinations). For these calculations, the deferred annuity factors using the static approximation diverge even further from the generational factors than those determined using current levels of stabilized rates.

Given the most probable direction of §430 valuation interest rates and the fact that certain calculations already use considerably lower interest rates, the IRS may want to consider whether its objectives would be better met by developing the static approximation in a manner such that deferred annuity values would more closely align with the generational approach at lower interest rates.

We recognize that it may be impossible to develop a single static approach that is fully equivalent to a generational approach, and believe that the proposed approach does an admirable job of balancing the competing objectives of simplicity and comparability. Achieving a better match for deferred annuities likely comes at the cost of increasing the mismatch at older ages. As an alternative to modifying the static table, the IRS could consider requiring the use of generational mortality for larger plans and permitting the use of the simplified, static table only for smaller plans. The vast majority of large plans are advised by actuaries with the capability to perform valuations using generational mortality projection. In fact, nearly all large plans are already applying mortality projection on a generational basis for valuations required to satisfy accounting standards under ASC 715-30 or IAS 19.

Substitute Mortality Tables

We appreciate the significant challenge inherent in addressing partial credibility and the development of substitute mortality tables that would be appropriate for a wide array of plans of varying size. While we favor an approach that allows an adjustment for not only the overall level of mortality experience but also differences in the shape of the mortality curve, we appreciate the complexity involved in applying graduation techniques and IRS/Treasury's concern about making such an rigor and simplicity of application. We have several comments regarding specific aspects of the approach outlined in the proposed regulations.

Enhancing Clarity and Understanding

We suggest that the procedure for the calculation of full credibility should be written as a formula in addition to the lengthy and complicated wording currently in the proposed regulations. This will reduce the chance of someone misunderstanding the required calculation. In addition, the proposed regulations provide for adjustment to the benefit dispersion factor for partial exposures. However, as currently written, the regulations do not show how to adjust for people leaving on account of reason other than death.

Although both formulas currently described in words (and adjusted for partial exposures) do appear in some available references, we propose that the IRS include the full formula in the regulations to aid in understanding and application of the formulas in practice. For reference, the attached Appendix 1 includes the formulas for benefit-weighted full credibility with partial exposures explicitly incorporated.

With respect to partial years' exposures, the proposed regulations make a specific reference to "adjusted, as appropriate, for people who leave on account of reason other than death..." However, the analysis reflects only those participants who are in the population at the beginning of the year, excluding participants entering the population with a partial year of exposure. The treatment of partial years' exposure generally has little effect on the overall plan experience, but we see no reason to treat midyear departures in a manner that is inconsistent with the treatment of midyear entrants. As such, we would request that the treatment of partial years' exposure be left to actuarial judgment and, to the extent references are made to partial exposure, that those treat entrants and departures consistently.

A final technical comment relates to the adjustment of the mortality curve developed by multiplying a reference curve by a mortality ratio. This approach would produce mortality rates that could be distorted at the oldest ages and that would never reach 100 percent. For example, if the plan-specific mortality ratio is 0.85, the adjusted mortality rate at age 120 will be 85 percent and not 100 percent, if applying simple multiplication for the entire table. We suggest that at the very least the age 120 rate always be 100 percent. Alternatively, IRS might consider providing that the generally applicable table be used after a certain age. For example, the variations on the RP-2014 tables (e.g., collar-adjusted, disabled, etc.) are generally the same after age 100, so that might be an appropriate age for the plan-specific tables to revert to the generally applicable tables.

Additional Simplifications

IRS and Treasury requested comments regarding additional simplifications that might be appropriate for use in developing substitute mortality tables. In general, we believe the approach in the proposed regulations is relatively easy to apply. However, we note that the proposed methodology may present certain challenges in the event of a corporate transaction.

In the event of a plan acquisition from another controlled group, the sponsor has the option to either use experience prior to the acquisition date or ignore it. If pre-acquisition experience is excluded, it appears that the acquiring sponsor must begin considering post-acquisition experience from the date of the transaction. For a midyear transaction, plan data may not always be readily available that is reconciled to year-end in a manner to support its use in developing substitute mortality tables. While plans using substitute mortality could be required to obtain such data, we believe it would be reasonable to permit experience for such an acquired group to begin as of the end of the plan year

during which the acquisition occurred. Without this allowance, it appears that a plan acquired midyear could be required to start monitoring deaths beginning on that date. Further, if the plan has sufficient deaths by the one-year anniversary of the acquisition, the sponsor would be required to reflect experience for the acquired plan the following year. Consider, for example, a transaction occurring on July 1, 2018, for a calendar year plan. The end of the one-year experience study period (June 30, 2019) would be after the deadline for applying for plan-specific mortality for the 2020 plan year. Thus in some cases the end of the one-year experience study period could be later than the application deadline for use of plan-specific mortality. It is not clear that the proposed regulations, as written, would allow a plan sponsor to avoid this problem by allowing consideration of only those experience study periods that end at least a year prior to the valuation date, in which case this experience could be disregarded as the relevant study period would be less than a full year.

Automatic Approvals

The remainder of this letter assumes automatic approval for using substitute mortality tables will not be available for the 2018 plan year. Given that the methodology defined in the proposed regulations is reasonably simple to apply, we encourage IRS and Treasury to consider providing some form of automatic approval process in future years if there is sufficient evidence from the applications submitted that plan administrators and their actuaries are accurately applying the prescribed methodology. Appropriate limitations could be imposed so that specific circumstances posing ongoing concern could still require IRS approval before implementation.

Full and Partial Credibility Threshold

Comments were also requested regarding whether the proposed threshold for determining partial credibility is appropriate, or whether a different number of deaths should be used for this purpose. We note that, under the proposed regulations, a plan must have much more experience to be fully credible after reflecting the population's benefit dispersion factor than is required under the current regulations, which rely solely on the number of deaths. Currently, a full plan-specific table is permitted with only 1,000 deaths per gender. Under the proposed regulations, those same 1,000 deaths per gender might be only 70 percent to 80 percent credible. Although the benefit-dispersion adjusted full credibility threshold is more actuarially precise, this change may produce substantial differences for many plans currently using substitute mortality. These differences may be exacerbated by the inability to reflect differences in the shape of the plan's actual mortality curve compared to the generally applicable tables.

Separate Analysis for Subpopulations

IRS and Treasury posed several possible exceptions to the rule on separating the subpopulations using criteria other than gender and annuitant/non-annuitant status. We support providing plan sponsors reasonable flexibility to analyze their participant demographics and develop a substitute table that best reflects their own experience, when there is sufficiently credible support for doing so. This flexibility would ideally apply to both the overall level of mortality and variances in the mortality experience at different ages relative to the generally applicable tables. However, we acknowledge that, short of allowing an approach using graduation similar to the current regulations, this objective is difficult to achieve.

Generally, we believe that allowing plans to divide their participants into separate subgroups (based on characteristics such as location, union status, or even age), even where each subgroup has only partial credibility, would offer plan sponsors flexibility to structure substitute mortality tables in a manner that best reflects their individual plan experience. As this approach will generally reduce the

overall credibility of controlled group experience, and move the result toward the standard table, we do not see potential for abuse as long as the population is not divided into a fully credible sub-standard group, along with multiple partially credible groups with greater longevity that are being split up simply to dilute the effect of their more favorable mortality experience.

When splitting populations into subgroups by age, application of separate mortality ratios to the population subsets can create discontinuities in the mortality rates when moving from one group to the next. For example, splitting an annuitant population into “those under age 85” and “85 and older” would create a potential disconnect at age 85. IRS and Treasury should consider whether this would be acceptable (based on the overall effect on liabilities), or whether some sort of simplified graduation technique must be applied to provide a measure of smoothing, such as an approach similar to the approach the IRS uses to transition between annuitant and non-annuitant rates in the small-plan combined tables.

IRS and Treasury also asked whether there should be a rule to “normalize” the mortality tables for separate sub-populations so that the total number of expected deaths for the separate sub-populations is the same as the total number of expected deaths for the entire population without regard to the separation. We believe that this is theoretically consistent with actuarial credibility practices. However, modeling prepared by members of the committee indicates that when such normalization is applied, it undoes most of the impact of subdividing the population and adjusting for smaller groups with only partial credibility. Once the normalization is applied, the effect on the resulting plan liabilities (compared to simply multiplying by a single ratio) is generally not material. (An illustration of how sub-population partial credibility might work, and the effect of normalization, is included in Appendix 2.)

Despite the offsetting effect of refining the mortality ratios by subdividing the participant population into smaller, partially credible groups (rather than requiring the larger, full-credible groups to be used), and subsequently normalizing for the overall level of mortality (which could be viewed as negating the benefit of subdividing the population), allowing this as an option would give plan sponsors the flexibility to reflect both overall levels of mortality and disparity between plan sponsor experience and the shape of the generally applicable tables. Splitting a population into different subgroups might, in some cases, reduce the benefit dispersion factor and allow the subgroups to achieve lower full credibility thresholds (and therefore increase the partial credibility of the smaller population). It is difficult to see how this leveraging effect could be used in an inappropriate manner. Because IRS and Treasury is proposing that all substitute tables be subject to review and approval prior to implementation, there is a backstop against a plan sponsor using any of the proposed refinements to the partial credibility rules to “game” their valuation results.

Use of Collar Adjustment as an Alternative to Using Mortality Ratios

An additional alternative to the partial credibility approach outlined in the proposed regulations would be to allow plans to use one of the published collar-adjustment tables that accompanied the RP-2014 table to reflect the nature of the covered workforce. The primary benefit of this approach is that it would allow for a reasonable adjustment to reflect plan characteristics for plans that might otherwise not have sufficiently credible experience to do a study.

In determining whether a plan qualifies to use a collar adjustment, a threshold must be established to determine the demographic characteristics of the covered participant population. In general, we

believe a 70 percent concentration of either blue collar or white collar workers⁴ and retirees (on a benefit-weighted basis, rather than headcount-weighted) would be sufficient to allow for use of a collar-adjusted table for the applicable plan population. The Society of Actuaries used such a 70 percent threshold during the RP-2014 data collection process to have employers self-identify plan populations as blue, white, or mixed collar.⁵

The rules regarding use of plan-specific mortality across the entire employer's controlled group would apply, so that a plan choosing to reflect blue or white collar adjustments would cause all other plans in the controlled group to be required to reflect their own mortality experience (whether through a collar adjustment or use of mortality ratios). We believe plans should be allowed to mix and match their approach to reflecting partial credibility (e.g., one plan might choose to use a collar adjustment while a different plan could use the partial credibility and mortality ratio approach). As the collar-adjustment option is primarily intended to help plans or groups that have a relatively low amount of plan-specific experience, it might be reasonable to require that if an employer uses a plan-specific analysis instead of a collar adjustment for any group, then any other large group for that employer (measured based on deaths in excess of the partial credibility threshold) must also use a plan-specific analysis.

For plans that benefit a mixed-collar population that is predominantly either blue or white collar, the demographic mix between collar types can change over time. For example, a previously mixed-collar workforce where benefit accruals are frozen for non-union employees may find its active participants meet the 70 percent threshold to apply a blue-collar adjustment while the inactive participants are still mixed-collar.⁶ In this case, a plan could be permitted to use collar-adjusted tables for those participant groups that meet the 70 percent test and be required to use the generally applicable tables (without collar adjustment) for participant groups (e.g., annuitant vs. non-annuitant) that cannot meet the 70 percent test, or do a population-specific analysis.

Approval to use a collar adjustment could be granted pursuant to a request to the IRS that would include data about the workforce and retiree group. In some circumstances it might be appropriate to allow automatic approval for a collar adjustment. While we appreciate there may be concerns about providing an automatic approval process for plan-specific mortality adjustments, there may be some instances where automatic approval to use a collar-adjustment might be allowed. For example, a plan with no other defined benefit plan in its controlled group might be allowed to use a collar adjustment without requiring preapproval. This allowance could be conditioned on inclusion with the annual Schedule SB a demonstration showing how the plan meets the threshold test (or, if different subgroups have different demographics, a demonstration with respect to each subgroup). IRS and Treasury could also require the plan to provide a specific mortality study if they suspect that a plan is

⁴ Following the definition used by the RPEC in the construction of the RP-2014 mortality tables, we would suggest the definition of blue collar be taken to be either union-represented or FLSA non-exempt. The definition of white collar would, consequently, be non-union represented and FLSA exempt.

⁵ The Society of Actuaries applied the 70 percent test threshold on a headcount-weighted basis, so the threshold suggested here is not identical to that used in the RP-2014 study. Applying the threshold on a benefit-weighted basis protects against allowing a plan that has a 75 percent blue collar workforce to use the blue-collar adjustment when the other 25 percent of the plan participants are white collar workers with substantially higher earnings (and by extension larger benefits and higher associated benefit liabilities).

⁶ In the example noted, the blue collar adjustment would apply to all current active employees both while active and after termination or retirement. Otherwise, the shift to the generally applicable tables would generate a loss upon exit from active participation.

not applying an appropriate collar adjustment in light of the Schedule SB attachment and/or nature of the covered workforce as defined by the plan's terms.

Aggregation of Male and Female Experience

All of the approaches to developing plan-specific tables discussed within the proposed regulations and our comments above have assumed that male and female populations should be analyzed separately. IRS and Treasury might consider, under appropriate circumstances, allowing a plan to aggregate its male and female participant mortality experience to develop a single mortality ratio for the plan that would then be applied to adjust both the male and female generally applicable tables.

While it is generally true that male and female participants within a plan demonstrate different relative mortality, for many populations the relative mortality level of males and females is at least directionally similar (i.e., both genders experience relatively higher or lower mortality than the standard tables). Intuitively this makes sense, as the male and female participants within a plan often (but not always) work under the same environmental conditions, in a similar geography, and may be of similar economic status—all factors known to influence mortality rates within a population. Other populations whose relative mortality experience might be expected to differ significantly (e.g., white and blue collar, annuitant and non-annuitant, young and old) are not only permitted but generally required to be aggregated, so it seems no less reasonable to permit aggregation of different genders whose relative mortality experience is directionally similar to achieve greater credibility.

For plans that do not have enough data for full credibility for at least one gender, permitting aggregation of male and female experience would increase the level of partial credibility that can be achieved (or perhaps allow the combined group to achieve full credibility). The current proposal to require separate assessment of male and female experience means that those plans that have a workforce that is not dominated by a single gender must have more overall deaths to achieve a level of credibility than a similarly sized plan that is predominantly male or female. Allowing aggregation of male and female experience where there is an acceptable level of homogeneity of experience puts those plans with a mixed-gender workforce in a similar position to their single-gender-dominated counterparts.

Construction of §417(e) tables

Although the proposed regulations do not address the construction of the §417(e) table, we expect this table will be a 50/50 blend of the static, small-plan combined annuitant and non-annuitant §430 tables. As noted above, we agree with the universal application of static mortality tables for lump sum determination under §417(e). Many plan sponsors and administrators will appreciate not having to reprogram their administrative systems to reflect generational mortality. While most large plan valuation systems are capable of incorporating generational mortality, the same is not true for many administration systems.

However, similar to our comments on the static approximation proposed for the §430 valuation basis, we note that the static approximation does not provide a good fit to the generational approach for low interest rates (as we are currently experiencing) and for deferred annuity factors, which will generally be lower using static mortality than generational. While all plan participants should expect to see an increase in lump sums (typically around 4 percent) due to the updated mortality basis, younger participants would see a much larger increase under a generational approach than under the static approach.

We realize that there are competing objectives, and that selecting a reasonable static option is a matter of balancing those objectives. A static approach that increases lump sum payments for younger participants would likely also increase lump sums for older participants beyond the level that would be produced by a generational approach. As the bulk of lump sums, measured in dollars, are likely paid to older participants, some will say that the trade-offs embedded in the proposed static table are appropriate. Others, however, will say that an approach that better matches the generational approach for younger participants would be worth pursuing.

We observe that the relationship of the proposed generally applicable and static alternative tables with respect to deferred annuity factors is generally linear during the deferral period. This suggests that adding a load factor to deferred-basis lump sums that is a linear function of the remaining deferral period (e.g., 0.1 percent for each year of deferral) would help to close the gap between the generational tables and what we assume the §417(e) tables will be. Of course, while making such an adjustment would produce a better match between the unisex static basis and the generational approach, it introduces an additional level of complexity in the calculation of §417(e) payment forms for which the implementation cost (considering that many plan administration systems would require individual plan-by-plan updates) might outweigh the refinement to the calculation. However, participants are likely to elect a deferred-basis lump sum anyway if offered them despite any disclosure that might be provided by the plan sponsor about the uncertainty of future lifetimes and how that uncertainty is reflected in the lump sum calculation. Closing the gap between generational and static projections for §417(e) purposes might be appropriate. On the other hand, given the range of opinions about the extent of future mortality improvement, reflecting a more conservative estimate of that impact (i.e., a projection less than fully generational for deferred annuity factors) might also be appropriate.

Challenges for Large Multiple Employer Plans

A number of large multiple employer plans comprise an aggregation of many different employers from different controlled groups, with no single employer representing the majority of participants. For these plans, it would be helpful if the regulations explicitly allowed for the development of plan-specific mortality without any consequences for other plans in the controlled groups of the participating employers. The multiple employer plan may not have any control over activities of its participating employers and may not be able to impose the analysis necessary to confirm whether the other plans, if any, are too small to have credible experience or to require the development of a table where another plan does have credible experience.

This problem is less likely to arise when a single employer dominates the multiple employer plan and the other participating employers are much smaller. Accordingly, the exception requested above could be limited to controlled groups that comprise less than half of a multiple employer plan's total population. This determination could be made on some reasonable basis, such as the share of the plan's funding target.

Multiemployer Plans

Multiemployer plans are not subject to §430; however, current liability must currently be measured based on the standard §430 tables. It might be appropriate to allow a multiemployer plan to develop a plan-specific table based on its credible experience, or use a collar-adjusted table, determined as described above, for this purpose. While not having the option to reflect their own credible mortality data may not be a significant issue for these plans, we see no reason why they should not be permitted to do so if they are large enough, and have sufficiently clean data to allow for an accurate analysis of the plan's experience.

We appreciate the IRS and Treasury giving consideration to these comments. Please contact Monica Konaté, the Academy's pension policy analyst, at 202-223-8196 or konate@actuary.org if you have any questions or would like to discuss these comments further.

Respectfully submitted,

Ellen L. Kleinstuber, MAAA, FSA, FCA, FSPA, EA
Chairperson, Pension Committee
American Academy of Actuaries

Appendix 1: Formula for benefit-weighted full credibility with partial exposures explicitly incorporated

The Life Valuation Subcommittee of the American Academy of Actuaries published the *Credibility Practice Note* in July 2008¹ to provide education for actuaries regarding common practices and approaches with respect to actuarial credibility theory. Among the methods discussed in this practice note is limited fluctuation credibility theory and the use of mortality ratios, which is the basis reflected in the proposed regulations. In the practice note, formulas for the benefit-weighted full credibility criterion are presented and partially derived (see page 19) that assume full-year exposures only. Following is a summary of the formulas applicable for the benefit-weighted full credibility criterion incorporating partial-year exposures.

Assume that for each of $i = 1, \dots, g$ ages or groups, we have n_i observations. For the j^{th} observation from the i^{th} group, b_{ij} is the accrued benefit (or benefit payable if in pay status), f_{ij} is the fraction of year the person could have been observed, q_i^s refers to the mortality rate from the standard (i.e., reference) table for the i^{th} group, and d_{ij} is 1 if the person died, and 0 otherwise.

The expected value and variance of the single mortality ratio is estimated as follows:

$$\hat{\mu} = \hat{m}, \text{ and}$$

$$\hat{\sigma}^2 = \sum_i \sum_j b_{ij}^2 f_{ij} \hat{m} q_i^s (1 - f_{ij} \hat{m} q_i^s) / e^2$$

In the formula above:

- e^2 is a square of expected benefit weighted deaths, or $(\sum_i \sum_j f_{ij} q_i^s b_{ij})^2$,
- \hat{m} estimates $\frac{\sum_i \sum_j f_{ij} d_{ij}}{\sum_i \sum_j f_{ij} q_i^s}$ for true mortality rates under our assumption, and
- $\frac{\lambda_0 \hat{\sigma}^2}{\hat{\mu}^2} \leq 1$ is the condition for full credibility under limited fluctuation theory.

The full credibility criterion is calculated as

$$\frac{\lambda_0 (\sum_i \sum_j f_{ij} q_i^s) \sum_i \sum_j b_{ij}^2 f_{ij} q_i^s}{(\sum_i \sum_j f_{ij} q_i^s b_{ij})^2}$$

Assuming a margin of error of 5 percent and confidence level of 90 percent, λ_0 is rounded in the regulations and in common practice to 1,082.

If all exposures are equal to 1 (i.e., all exposures are observed for a full year), this formula simplifies to the one described in the proposed regulations.

¹ http://www.actuary.org/files/publications/Practice_note_on_applying_credibility_theory_july2008.pdf

Appendix 2: Example and potential process to allow for smaller age groups and normalization

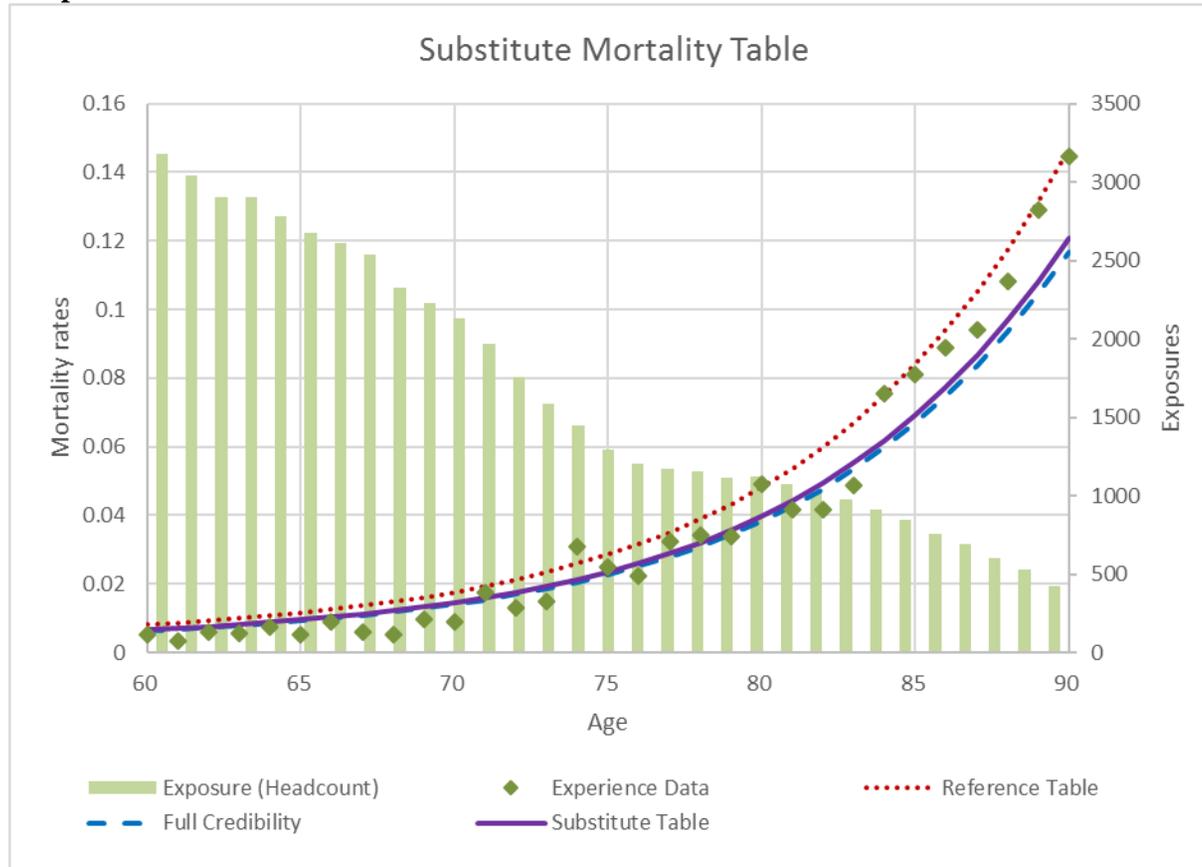
In order to apply the benefit-weighted calculation of the full credibility standard in the proposed regulations, the experience study data would need to be tabulated by age. The following data will be required by age:

- count exposure,
- benefit exposures,
- reference table mortality rates adjusted to the central year of the study,
- sum of benefits,
- sum of benefits squared,
- actual benefit-weighted deaths, and
- count of deaths.

With this information, tabulated by age, the full credibility threshold and partial credibility can be calculated for any broad subgroup just as easily as it is for the full group.

Graph 1 illustrates an example of experience study data, where even by a visual inspection raw experience death rates indicate a potential different shape for the mortality curve. For older ages, the mortality experience appears close to the reference table, while for younger ages observed mortality rates are consistently lower than either the reference rates or the reference rates multiplied by the total (adjusted for partial credibility) mortality ratio.

Graph 1



Combining data into 5-year age subgroup produce the data summarized in Table 1.

Table 1: Combining into 5-year age groups

Group ending with age	Actual Deaths	A/E Deaths Ratio	Full Credibility Threshold	Partial Credibility Level
60	81	0.5847	2,749	0.1717
65	104	0.5522	2,569	0.2012
70	135	0.5221	2,258	0.2445
75	157	0.8453	1,967	0.2825
80	251	0.8765	1,714	0.3827
85	286	0.8402	1,563	0.4278
85+	416	0.9614	1,608	0.5086
Total	1430	0.7964	1,920	0.8631

The visual observations noted above can now be put in mathematical terms:

- the first three consecutive groups have A/E or mortality ratios within 6 percent,
- the next three consecutive groups have considerably higher A/E ratios, again within small margin (3 percent) of one another, and
- the oldest group has considerably higher A/E ratio.

The overall mortality ratio for the total population does not appear to be a particularly good fit to any of these age-banded groups. Mathematical criteria can be developed to account for combining these smaller age subgroups to larger ones, each with a very different mortality ratio than the total dataset combined.

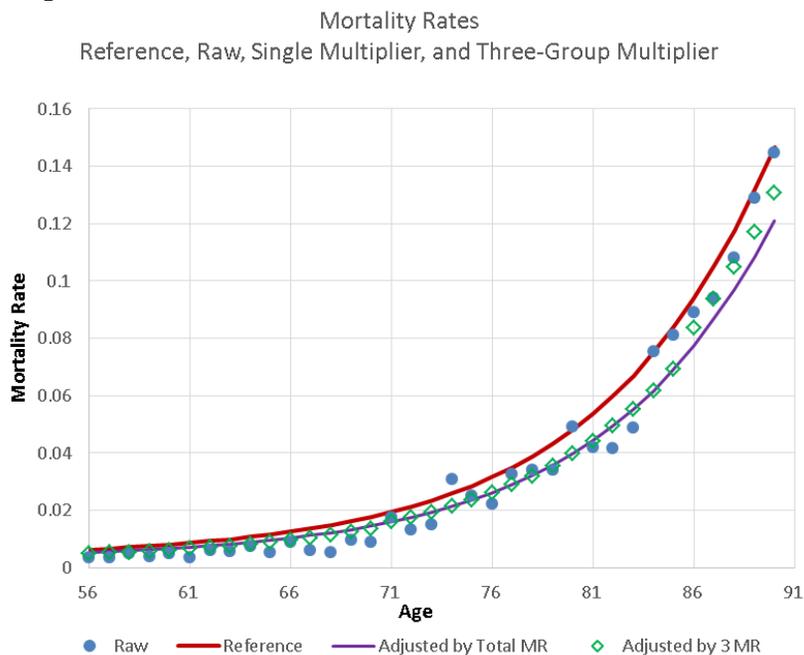
In this example, it seems reasonable to combine this population of annuitants into three groups—ages 70 and below, ages 71 to 85, and ages 85 and above. The results of the calculation of partial credibility adjusted mortality ratios for each subgroup and the subsequent normalization process are shown in Table 2. Normalization factor is calculated by dividing total credibility-adjusted expected deaths by the sum of credibility-adjusted expected deaths in age subgroups (column before last). In the last column, credibility adjusted A/E ratios are multiplied by the normalization factor. Some columns do not add up due to rounding.

Table 2: Combining Groups with Similar A/E Ratios

Age Groups	Exp. Deaths	Actual Deaths	Expected Ben Deaths	Actual Ben Deaths	Expected B ² /10,000	A/E Ratio	Full Credibility	Partial Credibility	Credibility Adjusted A/E	Credibility-Adjusted Exp. Ben. Deaths	Normalized A/E
<i>to 70</i>	435	320	9,962,012	5,492,900	53,974,526	0.5514	2559	0.3536	0.8414	8,381,544	0.7646
<i>71-85</i>	737	694	16,336,964	13,923,650	56,818,615	0.8523	1698	0.6394	0.9055	14,793,897	0.8229
<i>85+</i>	405	416	9,251,458	8,894,800	31,438,669	0.9614	1608	0.5086	0.9804	9,070,071	0.8909
Total	1576	1430	35,550,434	28,311,350	142,231,809	0.7964	1920	0.8631	0.8242	29,302,380	0.8242
Normalization Factor:										0.9087	

Graph 2 illustrates the reference mortality curve, raw experience rates, and the two curves obtained by a single multiplier approach and three-group multiplier approach described in this example. The impact on present value factors for individual ages that results from allowing for the three-group approach rather than requiring a single mortality ratio to apply to all ages can be significant, as illustrated in Graph 3. However, after applying the normalization process, the overall impact on total plan liabilities between the three-group approach and the single mortality ratio approach is only about 0.4 percent.

Graph 2



Graph 3

