A PUBLIC POLICY PRACTICE NOTE

Selecting and Documenting Mortality Assumptions for Pensions

Revised October 2011

American Academy of Actuaries
Pension Committee

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Developed by the Pension Committee
of the American Academy of Actuaries

AMERICAN ACADEMY *of* ACTUARIES

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[1] and other post retirement benefit plans

This practice note does not cover the selection and documentation of assumptions other than the mortality assumption.

2011 Pension Committee

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INTRODUCTION

This practice note is not a promulgation of the Actuarial Standards Board, is not an Actuarial Standard of Practice, is not binding upon any actuary and is not a definitive statement as to what constitutes generally accepted practice in the area under discussion. Events occurring subsequent to the publication of this practice note may make the practices described in the practice note irrelevant or obsolete.

This practice note was prepared by the Pension Committee of the American Academy of Actuaries (Academy) to provide information to actuaries on current and emerging practices in the selection and documentation of the mortality assumptions for measuring obligations of defined benefit pension plans and other post retirement benefits plans. It represents collective, but not unanimous, views of the individual members of the Committee. The intended users of this practice note are the members of actuarial organizations governed by the Actuarial Standards of Practice promulgated by the Actuarial Standards Board.

Measurements of defined benefit pension plan obligations include calculations that assign plan costs to time periods, actuarial present value calculations, and estimates of the magnitude of future plan obligations. This practice note does not apply to individual benefit calculations or individual benefit statement estimates. The application of the information contained herein is intended to cover qualified and non-qualified plans, and governmental and non-governmental plans for which the actuary is subject to ASOP No 35.

This note may be used when setting assumptions, or providing advice on setting assumptions, for funding (where permitted by law), and for financial accounting.

This practice note does not cover the selection and documentation of investment return assumptions, other economic assumptions, or non-mortality demographic assumptions.

Mortality rates that are appropriate for valuing pension obligations may not generally be appropriate for valuing life insurance or individual annuity contracts. The issues involved in selecting mortality assumptions for life insurance (both individual and group) or individual annuity contracts are not addressed in this practice note.

This practice note is intended to assist actuaries by describing some approaches for selecting (including giving advice on selecting) and documenting mortality assumptions that the Committee believes could be employed to comply with Actuarial Standard of Practice No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations* ("ASOP No. 35"). Actuarial Standard of Practice No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions* ("ASOP No. 4"), when revised in 2007, integrates the guidance from ASOP No. 35 and

certain other standards on measuring pension obligations as well as providing guidance on the actuary's responsibility with regard to prescribed assumptions.[2,3, 4]

This practice note replaces the October 2009 version and may be considered for any actuarial valuation with a measurement date on or after June 30, 2011 (which is the effective date of the revised ASOP No. 35 as revised and adopted in September 2010). Actuaries are encouraged to review the revised ASOP carefully, noting among other things the requirement to specifically select and disclose a future mortality improvement assumption.

The Transmittal Memorandum in the revised ASOP No. 35 states: "As mortality rates have continued to decline over time, concern has increased about the impact of potential future mortality improvements on the magnitude of pension commitments. Section 3.5.3 of current ASOP No. 35 lists 'the likelihood and extent of mortality improvement in the future' as a factor for the actuary to consider in selecting a mortality assumption. In the view of many actuaries, the guidance regarding mortality assumptions should more explicitly recognize estimated future mortality improvement as a fundamental and necessary assumption, and the actuary's provision for such improvement should be disclosed explicitly and transparently."

This practice note is intended to be illustrative and spur professional discussion on this topic. Other reasonable selection and documentation methodologies currently exist and new ones likely will evolve in the future.

The Committee welcomes any suggested improvements for future updates of this practice note. Suggestions may be sent to the pension policy analyst of the American Academy of Actuaries at 1850 M St. NW, Suite 300, Washington, DC 20036 or by emailing pensionanalyst@actuary.org.

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[2] In the event of a conflict between the guidance provided in ASOP No. 4 and the guidance provided in ASOP Nos. 27 and 35, ASOP No. 4 governs.

[3] In December 2010, the Actuarial Standards Board (ASB) adopted revisions to Actuarial Standard of Practice No. 41, *Actuarial Communications* ("ASOP No. 41"). ASOP No. 41 affects the actuary's responsibility regarding required disclosures concerning assumptions and regarding prescribed assumptions. Actuaries are encouraged to familiarize themselves with the requirements of ASOP No. 41.

[4] As part of the review of ASOP No. 27, the Pension Committee of the ASB is considering requiring the actuary to disclose the rationale for the selection of the economic assumptions. If this change is adopted, ASOP No. 35 may be amended in the future to make changes parallel to the changes in ASOP No. 27. At the date of this Practice Note, ASOP No. 4 is under consideration for update and revision.

I. Mortality Assumptions

General Requirements of ASOP No. 35

The Actuarial Standards Board (ASB) originally adopted ASOP No. 35 in 1999. The ASOP was revised in September 2007, to be consistent with the other standards providing guidance on measuring pension obligations, and again in September 2010. ASOP No. 35, Section 3.1 provides that 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." According to ASOP No. 35, a reasonable assumption is "one that is expected to appropriately model the contingency being measured and is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period." It outlines a general process an actuary should follow for selecting demographic assumptions and generally describes the following in Section 3.3:

- Identify the type of assumption that is appropriate for the specific calculation;
- Consider the relevant assumption universe (e.g., published tables, plan experience, published studies, etc.) from which a specific assumption may be selected;
- Consider the assumption format and whether it is appropriate to use different assumptions for different segments of the covered population;
- Select the specific assumption from the relevant universe; and
- Evaluate the reasonableness of the selected assumption.

An actuary need not follow this entire process at every measurement date for every assumption if, in the actuary's professional judgment, previously selected assumptions continue to be reasonable. Each individual demographic assumption selected by the actuary should satisfy the standard. With respect to any particular measurement, each demographic assumption selected by the actuary should be consistent with the others unless the assumption, considered individually, is not material. The combined effect of all nonprescribed assumptions (including those not covered by this practice note), however, should be reasonable.

ASOP No. 35 applies not just when an actuary selects an assumption, but also when an actuary gives advice on selecting an assumption (Section 3.8, including prescribed assumptions). In addition, ASOP No. 4 provides guidance on the actuary's responsibility with regard to prescribed assumptions selected by a plan sponsor (such as employer-selected assumptions to comply with Statements of Financial Accounting Standards). ASOP Nos. 35 and 4 do not apply to mandated prescribed assumptions (e.g., Internal Revenue Code Regulation 1.430(h)(3)-1).

Where a particular assumption is prescribed, ASOP No. 35, Section 3.8 does not appear to authorize the actuary to select another assumption that would not satisfy the standard

on its own in order to offset the effect of using the prescribed assumption. This appears to be true even when the actuary believes the prescribed assumption is unreasonable, unless the disclosure of deviation provisions of the standard are followed.

More than one reasonable assumption may exist for measuring the same contingency. The actuary may select one reasonable assumption, or may show the results using several reasonable assumptions, to show the effect of the difference in assumptions.

General Framework of Mortality Assumptions

Selection of a mortality assumption generally involves a two-step process: (1) choosing an appropriate set of base mortality tables, and (2) selection of (past and future) mortality improvement rates.

Selecting Mortality and Mortality Improvement Assumptions

Section 3.5.3 of ASOP No. 35 provides guidance on the selection of the mortality and the mortality improvement assumptions and generally states that the actuary should consider factors such as:

- Whether to use different assumptions before and after retirement, including the reasonableness of an assumption of no mortality before retirement in the case of a small plan;
- Whether different assumptions should be used for disabled lives, considering the plan's definition and/or administration of disability provisions; and
- Whether assumptions should differ for certain participant subgroups.

The amended ASOP states, "the actuary should consider the effect of mortality improvement both prior to and subsequent to the measurement date" and should do the following:

- Adjust mortality rates to reflect mortality improvement prior to the measurement date; however, the published mortality table without improvement can be used if it reflects expected mortality at the measurement date, in the actuary's professional judgment; and
- Adjust mortality rates to reflect mortality improvement after the measurement date and, in particular, an actuary's uncertainty about the occurrence or magnitude of future mortality improvement should not be used as the sole determinant of an assumption of no future mortality improvement.

When choosing an appropriate mortality assumption, actuaries typically use standard mortality tables, unlike when choosing other demographic assumptions (see Appendix 1 for a list of current (2011) standard pension mortality tables).[5] They may choose to adjust those standard mortality tables, however, to reflect various characteristics of the covered group, and to provide for expectations of future mortality improvement (both up to and after the measurement date). If the plan population has sufficient credibility to justify its own mortality table, then the use of such a table also could be appropriate. Factors that may be considered in selecting and/or adjusting a mortality table include the demographics of the covered group, the size of the group and the statistical credibility of its experience, and future mortality improvement. A more explicit discussion of these factors can be found in Section III of this practice note.

For most pension valuations, the actuary is generally not expected to reflect adjustments to current and projected future mortality rates for more than a few of the demographic factors potentially affecting mortality (see Q&A 1). In many cases, the size of the population will be too small to observe the effect of these factors on plan experience. Even for plans with the largest populations, the effect of many factors (with unknown correlations) operating simultaneously may be difficult to separate and measure. When making adjustments, actuaries may choose to reflect only the most predominant factors.

In addition, the actuary may want to consider the balance between a complicated methodology and the magnitude of the effect of increased precision. The use of a highly refined methodology, encompassing all possible factors that could influence mortality, is not necessary if the additional refinements are not expected to have a material effect on the actuarial results.

Standard Tables

Appendix 1 contains descriptions of selected current (2011) standard pension tables. Reference to any particular table is intended to be an example of a currently available table and should not be considered as an indication of current "best practice."

[5] At the time this practice note was issued, the Society of Actuaries was reviewing pension plan mortality experience and is expected to issue new mortality information, including a new set of base mortality tables as well as information about future mortality improvement. Actuaries should consider any new information that is issued in connection with the Society of Actuaries' study.

II. Disclosure and Documentation

Required disclosures about the mortality assumptions in pension actuarial communications are described in ASOP Nos. 4, 35, and 41, and generally include the following:

- Specific information about each material assumption that was used in the measurement so that another actuary reading the communication has sufficient information to make an assessment about the level and pattern of the rates and the reasonableness of the work. The disclosure of the mortality assumption should include a description of the provisions made for future mortality improvements.
- Discussion of any material changes in the assumption from the previous measurement, including a description of the changes and their general effects, in words or numerically, as appropriate;
- Discussion of any significant events that have occurred since the date of the measurement that would have materially changed the assumption, including the likely effect;
- Identification of any prescribed assumptions, including their sources;
- Identification of any prescribed assumptions selected by a plan sponsor that significantly conflict with what the actuary judges to be reasonable for the purpose of the measurement (note that for this purpose, a reasonable assumption is not limited to what the actuary would have selected as his/her best estimate);
- Identification of any prescribed assumptions selected by a plan sponsor that the actuary is unable to evaluate for reasonableness; and
- Discussion of any deviation from the procedures in ASOP No. 35, including the nature, rationale, and effect of the deviation.

If the actuarial communication is a required government form, the instructions of the applicable form govern disclosure and, other than the last four bullets above, the disclosures described above do not apply.

The actuary also may want to document the assumption selection in internal workpapers. This documentation may describe the assumptions selected for the analysis, the process used to review the assumptions, the results of any experience or gain/loss analysis, the impact of any special events, the impact of any assumption changes, and the basis for the selection of the assumptions used in the analysis.

III. Questions and Answers

Unless otherwise indicated, the following answers apply to selecting a non-prescribed mortality assumption for an uninsured defined benefit pension plan.

Q1. What are some of the demographic factors that may be considered when selecting a base mortality table and mortality improvement assumptions?

A1. The actuary may, but is not required to, choose separate tables and improvement scales for different demographic groups or may reflect the demographics of the covered group in selecting or adjusting a standard table and /or standard improvement scales. Demographic experience under the plan may be considered if it is credible. The types of demographics one might want to consider for mortality adjustments include:

- Collar (White, Blue, etc.)
- Income
- Gender
- Occupation
- Status (Active, Retired, Disabled, Inactive, Beneficiary, etc.)
- Early vs. normal retiree
- Country of residence or other more specific geographic location
- Form of payment
- Presence of medical coverage
- Employed vs. non-employed

A plan may be able to reflect its own experience if it is of sufficient size. (See Q&A 8).

As an example, more hazardous occupations and occupations with higher physical job demands may exhibit higher rates of mortality.

In the U.K., the use of generalized linear models (GLMs) to help better track and understand longevity exposure in pension plans has been increasing. Understanding longevity exposure is a significant issue for U.K.-based plans, especially because of mandatory benefit indexing and the growing pension settlement market. Instead of just counting deaths and dividing by exposures, these models help actuaries understand the many correlations in the data. Although this type of analysis is not prevalent in the United States, it may be something for actuaries to consider, especially for large plans. A paper entitled, "A Practitioner's Guide to Generalized Linear Models" can be found on the Casualty Actuarial Society Part 9 syllabus at www.casact.org/pubs/dpp/dpp04/04dpp1.pdf.

Q2. What factors need not be considered?

A2. Many factors affect mortality, some of which are considered when performing actuarial calculations for pension plans and some of which are not. For individual insurance policies, factors such as health status and risks are used to rate the individual. This type of data is generally not available from a defined benefit plan sponsor and thus may not be appropriate to consider directly. In a group setting, health status is generally inferred from the requirement that the individual be actively at work. In fact, many of the standard tables commonly used (see Appendix 1) are based on those who meet this standard. Thus, if the standard table, with adjustments discussed elsewhere in this note, is based on data similar to the characteristics of the group being valued, then these types of factors can be considered to have been properly reflected.

By Federal law, certain factors (e.g., race, gender) cannot be considered in developing certain tables (such as the tables used for lump sums and optional form of payment conversions). U.S. practice is to ignore race in the determination of the mortality assumption. Other factors, such as age and gender, may be considered. The use of gender depends on the context. U.S. practice generally is to take gender into account in determining costs and liabilities for defined benefit pension plans, but gender is not allowed as a factor in determining lump sums and conversion to other optional forms of payment under a qualified defined benefit pension plan. In all cases, applicable law applies. Other factors, such as collar[6] and income, may be reflected in the choice of assumptions. A list of other factors can be found at: www.soa.org/files/pdf/farm_phaseII_paper.pdf

Q3. What is the process for selecting appropriate mortality and mortality improvement assumptions?

A3. ASOP 35 outlines five primary steps in selecting assumptions (Section 3.3 of ASOP 35). Generally, the actuary should:

- Identify the type of assumption that is appropriate for the specific calculation;
- Consider the relevant assumption universe;
- Consider the assumption format;
- Select the specific assumptions; and
- Evaluate the selected assumption for reasonableness.

Q4. Are mortality tables that are based on the experience of the entire general population useful?

[6] Table 5-3 and the conclusion of that section in the RP-2000 Tables report indicate a statistically significant difference in mortality rates for blue vs. white collar.

A4. Those who are employed are generally healthier than those who are not employed. Mortality based on the general population will, on average, therefore exhibit higher rates of mortality than the rates exhibited by the universe of working participants. A population mortality table may be useful when valuing a group that includes non-workers (such as a social insurance program).

Q5. Separate tables are available for the purpose of valuing life insurance (both individual as well as group coverages). When are such tables useful in valuing pension or other post retirement benefit plans?

A5. Rarely. Individual life insurance tables reflect an element of underwriting and some anti-selection. While those tables may be appropriate for valuing and pricing individual life products, they may not be appropriate for valuing pension or other post retirement benefit plans. Tables used to determine life insurance statutory reserves are also not likely to be appropriate for valuing pension or other post retirement benefit plans. Group life insurance tables show a higher rate of mortality than would be expected for group annuity tables. They also are more reflective of current experience and do not reflect future anticipated experience as required for group annuity tables. Life tables also may include a margin for adverse experience, which in the case of a life insurance table results in an increase in the expected mortality rate.

Q6. What is the difference between a table used to value group annuity mortality vs. a table used to value individual annuity mortality?

A6. Individual annuities are generally purchased by individuals who think they will live a long time. Group annuities are generally purchased by employers or plans for groups of individuals who are not given a choice of whether the annuity will be purchased or not. Mortality experience under individual annuity contracts, therefore, tends to be lower than group annuity experience due to anti-selection by the purchasers of individual contracts. On the other hand, group annuity mortality tables reflect the anticipated experience of a group of employed persons. While the use of a group annuity table is generally more appropriate for valuing a pension plan, the use of an individual annuity table may be appropriate for predicting the mortality of principals of smaller organizations.

Q7. Are there different types of group annuity mortality tables?

A7. Yes. Different types of group annuity mortality tables are used depending on the purpose of the actuarial analysis. There are the reserving tables that are used to determine statutory reserves and what is called “surplus strain” (or the amount of capital used to support the sale of a particular group annuity contract). The tables used for these purposes include a load for adverse experience, i.e., for lower than expected mortality. The GAR-94 Table is one such table.

The other type of table does not include a load for adverse experience and is typically used to price a group annuity contract and to set Generally Accepted

Accounting Principles (GAAP) reserves. These tables reflect the best estimate of the anticipated mortality experience for the group being valued. The GAM-94 Basic with Scale AA applied on a generational basis is one example of a table that does not have a load for adverse experience built in.

For more information on current mortality tables, see Appendix 1.

Q8. Is it ever appropriate to assume no mortality?

A8. The absence of a pre-retirement mortality assumption could be reasonable if the small size of the pension population does not justify the use of a mortality assumption for the period prior to assumed retirement. (ASOP 35, Section 3.5.3(a)) This approach may be used to simplify the calculations when the use of a pre-retirement mortality table would not produce a materially different result (such as when a death benefit is provided that is equal to the actuarial reserve under the actuarial funding method). In most other cases a mortality assumption is used.

Q9. When is plan experience significant enough to be reflected in the mortality assumption?

A9. For most plans, the plan population may not be large enough to generate fully sufficient credible experience data. In those cases, published tables are available. When the plan population is sufficiently large, the mortality assumptions may be based on the use of a table based exclusively on the plan's experience or on a modification to a standard table. See the discussion on credibility theory in Appendix 2.

For plan populations that are large enough to have some degree of credibility, or for which experience has been observed over an extended period, the actuary may attempt to validate whether a published table aligns with current plan mortality levels. The actuary also may determine the extent to which the published table (or an adjustment to the table) provides a margin for future mortality improvement. The current mortality table validation process is an important starting point, even when a projection will be applied.

Q10. Should future improvements in mortality be assumed?

A10. The effect of future mortality improvement before and after the measurement date should be considered. Unlike most other decrements, mortality rates consistently have improved in the past. Data from mortality and demographic studies may be considered when determining the likelihood and extent of mortality improvement in the future. Past experience indicates mortality rates have continued to improve. There are many unknowns, however, such as whether there is a limit to mortality improvements and how the rate of mortality improvement is expected to change.

The actuary should consider reflecting mortality improvement from the effective

date of any base table used through the measurement date. The published mortality table without improvement can be used, however, if it reflects expected mortality at the measurement date in the actuary's professional judgment.

The actuary should consider reflecting an estimate of future mortality improvement in the mortality assumption after the measurement date. Section 3.5.3(ii) of ASOP No. 35 states, "the existence of uncertainty about the occurrence or magnitude of future mortality improvement does not by itself mean that an assumption of zero future improvement is a reasonable assumption."

Demographics and plan design are factors used when evaluating future mortality improvement. For example, the materiality of the mortality improvement assumption increases when:

- The group being valued is predominately active lives.
- The plan provides benefits that tend to increase over time (e.g., pension plans that grant automatic cost-of-living increases and many post-retirement medical plans that do not have a cap on company cost increases).

In some situations a projection of mortality improvements may require additional consideration such as:

- When the use of such a table is precluded by law or the purpose of the valuation calls for stated or mandated assumptions.
- When a significant portion of the pension plan population works in a hazardous occupation or earns lower income, and that is expected to significantly affect pre- and/or post-retirement mortality improvements.
- When the plan's benefits primarily are paid in a lump sum form or the death benefit is actuarially equivalent to the benefit payable under some other decrement(s) (e.g., turnover) such that the effect of mortality improvements would not be material.

What about projection of mortality improvements for disabled lives? According to the SOA report on RP-2000 mortality tables, "There were not sufficient consistent data to analyze trends for disabled retirees." In addition, unlike non-disabled mortality, there was no projected improvement in disabled mortality from the base year of the experience to 2000. Scale AA, therefore, may not be appropriate to project disabled mortality. This is an area that may need further analysis. In valuing disabled lives, the actuary may wish to reflect higher mortality (and recovery) rates, particularly at the earlier durations of disability.

There is a significant body of data and research regarding mortality improvement. Pension actuaries are encouraged to become familiar with these data and research findings. The Society of Actuaries has collected some of this information at http://www.soa.org/professional-interests/pension/resources/pen-mortality-resources.aspx

Q11. What sources are available to assist in choosing a mortality projection scale?

A11.

- Scale AA (see Appendix 1)[7], which was originally developed for use with the 1994 pension and annuitant tables, is currently a commonly used mortality improvement scale table. Other scale tables exist, including Scale H, which was developed for the 1983 GAM table.
- A summary of various scales that pre-date Scale AA can be found in Table I, page 229 at http://www.soa.org/library/research/transactions-reports-of-mortality-moribidity-and-experience/1980-89/1988/january/tsr889.pdf.

The 2001–02 Group Annuity Experience Committee (SOA) found that mortality improvements over a six-year period (1997–2002) were more rapid at higher annuity incomes and for males. This information can be found on page 5 at http://www.soa.org/files/pdf/resrch-01-02-group-annuity-reprt.pdf. The same Committee (SOA) paper (page 5) also indicates that the rate of improvement in female mortality was negligible over this period. A related Pension Section News article is found at http://www.soa.org/library/newsletters/pension-section-news/2006/april/psn-2006-iss61-binder.pdf.

- Studies by other professionals, such as demographers, also can be helpful in determining the rate and duration of mortality improvements. While most experts see a continued long term trend of mortality improvements, there are those who do not see mortality improving forever, given other trends (such as increased obesity, increases in sedentary lifestyles, increases in drug resistant bacteria, and the possibility of pandemic diseases). Actuaries are encouraged to look at the available materials, as it is necessary to establish a rationale for selecting a particular improvement scale or method.[8] Each of these factors may be considered carefully in selecting a mortality improvement scale and the time period over which it is to be applied.
- The paper on the development of the UP-94 Table (see Appendix 1) referred to continuous mortality improvements throughout most of the twentieth century. The paper also indicated that the trend of continued medical discoveries should cause actuaries to consider providing for mortality improvement in setting a best estimate. Appendix B of that paper further explores the issues in choosing a mortality improvement scale.

At the time this practice note was issued, the Society of Actuaries was reviewing pension plan mortality experience and is expected to issue both a new set of base mortality tables as well as information about projecting future mortality improvement. Actuaries should consider any new information that is issued in connection with the Society of Actuaries' study as well as relevant studies that may become available from other organizations subsequent to the issuance of this practice note.

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[7] Scale AA was developed jointly by the Uninsured Pensioner Mortality Subcommittee of the Retirement Plans Experience Committee of the Society of Actuaries and the Group Annuity Valuation Table Taskforce. Source: TSA 95, Table 3, pages 824-826, found at http://www.soa.org/library/research/transactions-of-society-of-actuaries/1990-95/1995/january/tsa95v4721.pdf Discussion of the application of a scale begins on page 827. Application of a scale begins on page 846. Static projections are discussed starting on page 858.

[8] For examples, see the information the Society of Actuaries has collected at http://www.soa.org/pension-mortality

Q12. What factors support the use of a static mortality table without projection of future mortality improvement?

A12. In some cases a static table with sufficient margin for mortality improvements may be appropriate. For example, the GAM-94 Static table (see Appendix I) employs this technique, as did several older tables (e.g., GA51, GAM71 and GAM83). Since these tables are static tables, however, they may become out of date, even though they include margins for future mortality improvement.

Another approach one may use is to select a table and then set back the age. As with a static table, a table with an age setback may become out of date.

If a static table has built in enough of a margin, then the use of such a table may be appropriate. Based upon the characteristics of the group being valued and the purpose of the valuation, use of such a table also may be appropriate.

Q13. What is the difference between a static and generational mortality projection?

A13. A static projection is a projection of the base mortality rates to a specific date that results in a table applied to all durations after the measurement date. For example, if a 15-year static projection is used, the mortality rate at age 65 for someone now age 40 will be the current age 65 rate with 15 years of projected mortality improvement applied. For the same person, the mortality rate at age 66 will be the current age 66 rate, also with 15 years of projected improvement in mortality.

A generational projection generates a unique table for each year of birth cohort. For example, the mortality rate at age 65 for someone now age 40 will be the current age 65 rate with 25 years of projection applied. For the same person, the mortality rate at age 66 will be the current age 66 rate with 26 years of projection.

Generational tables theoretically may replicate the anticipated pattern of improvement in mortality rates, but may be more difficult to use and may not significantly improve the accuracy of the actuarial present values when compared to those produced by the use of a static projection. Relative to generational tables, static projections may overstate liability for some participants and understate it for others. While this may be less accurate for each individual participant, it may produce a reasonable result for a larger diverse group.

The use of generational tables may improve the accuracy of benefit projections and liability forecasts.

Q14. If using static projection of mortality improvement, for how many years would one project that improvement?

A14. Comments were made in the papers for the RP-2000 and UP-94 tables (see Appendix 1) that a static projection to the duration of the liabilities provides an

appropriate approximation of future mortality improvement.[9] (See Q&A 21 for a discussion of duration). Note that this projection is for a specified number of years ("n"), for which the number of years is equal to (a) the number of years from the date of the table to the measurement date, plus (b) the duration of the liabilities.

If static projections are used, it may be more appropriate to use a different projection for different groups of participants—for example, those in pay status vs. those who are not in pay status, such as is required by the IRS under the current funding rules for single employer plans—to reflect the different duration of the liabilities for each group.

Q15. What about the use of differing annuitant vs. active vs. beneficiary mortality?

A15. The RP-2000 study indicates a difference between active and annuitant mortality. These differences may or may not be material in a given situation.

There generally does not appear to be sufficient data to determine a different mortality table for beneficiaries as compared to retirees of the same gender.

Q16. What about reflecting type of retirement?

A16. An actuary may choose to reflect the type of service retirement if it is material to the plan being valued. Early retirees tend to exhibit higher rates of mortality than normal retirees.[10] Mortality rates for disabled lives are higher than for those who retire from active service and mortality rates vary depending on the type of disability. For example, a fireman who is granted disability retirement because of an arm injury will not, in general, exhibit higher mortality rates than a fireman who takes a service retirement. Level of income also may be important in predicting the level of mortality. Studies have shown that even the form of payment chosen can be predictive of future mortality rates.[11]

Q17. When are unisex tables useful?

A17. Gender typically is reflected in the selection of mortality assumptions for valuation except where prohibited by law. A unisex table is appropriate when determining or valuing a lump sum form of payment, particularly when the table is a prescribed table. If a unisex table is used for other purposes, one should consider documenting the reason why such an assumption is appropriate in internal workpapers.

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[9] TSA 95, page 823. found at http://www.soa.org/library/research/transactions-of-society-of-actuaries/1990-95/1995/january/tsa95v4722.pdf.

[10] Report of Group Annuity Experience Committee Mortality Experience, Society of Actuaries, for 2001-2002, page 6, available at: http://www.soa.org/files/pdf/resrch-01-02-group-annuity-reprt.pdf

[11] Report of Group Annuity Experience Committee Mortality Experience, Society of Actuaries, for 2001-2002, pages 6 & 7.

Unisex tables can be used for non-annuitants if the results are not materially different than if sex-distinct tables were used. As an example, consider the pre-retirement mortality assumption for a hospital pension plan. If the employees are predominately female, perhaps a unisex table that is heavily weighted toward females could be used. The effect of this assumption depends, however, on the liabilities by gender as opposed to just the number of each gender.

See the answer to Question 2 for other considerations regarding the use of gender.

Q18. When is it appropriate to use select and ultimate mortality assumptions?

A18. Select and ultimate assumptions may be appropriate when the rate of mortality is affected by the length of time after a particular event, such as disability. Disability mortality tables generally include a higher probability of death and a probability of recovery in the years immediately following the disability. There may also be a return-to-work effect to be considered. If the disability benefit is a deferred benefit, then a select and ultimate assumption may not be needed.

Q19. Is it appropriate to reflect the collar of the covered workforce in the mortality assumption?

A19. Collar is one factor that may be considered in selecting a mortality assumption. This may be most appropriate when the population is clearly either predominately blue collar or predominately white collar. The collar effect was studied and discussed in preparation of the RP-2000 mortality table (see Appendix 1).

Q20. Is the industry of the population reflected?

A20. The paper on RP-2000 (see Appendix 1) indicated that industry of the population was not found to be a consistent predictor of mortality in the data collected.

Q21. If I use duration to establish a static projection, how could I determine duration?

A21. Several different methods can be used to determine duration and definitions can be found at http://www.soa.org/files/pdf/rp00_mortalitytables.pdf (Chapter 7) and at http://www.soa.org/files/pdf/03-RMTF-Duration.pdf

Q22. How could mortality experience be monitored?

A22. If credible experience can be obtained for a plan, an analysis of actual plan mortality experience versus assumed experience may be conducted and documented regularly.

Some actuaries review the pattern and size of actuarial gains and losses from the mortality decrement, with a more thorough analysis conducted if the results of this analysis indicate that the experience may be deviating from the assumption.

If credible experience cannot be obtained for a plan, a comparison of the mortality assumptions to past experience may not be useful. See Appendix 2 for a

discussion of credibility theory.

Other special events (e.g., plan spin-offs or mergers) can trigger a need for an additional review and documentation of the selection of actuarial assumptions. The actuary may want to consider whether the occurrence of the event could significantly alter the future experience of the plan and whether any assumption changes are warranted to better reflect that future experience.

Q23. What should be disclosed in the actuarial communication regarding the selection of a mortality assumption?

A23. See Section II of this practice note.

Q24. What might be documented in internal actuarial workpapers regarding the selection of a mortality assumption?

A24. Guidance regarding documentation is contained primarily in ASOP No. 41, Actuarial Communications. Beyond the guidance given in the ASOPs, documentation in internal workpapers could describe the assumptions selected for the analysis, the process used to review the assumptions, the results of any experience or gain/loss analysis, the effect of any special events, the effect of any assumption changes, and the basis for the selection of the assumptions used in the analysis. This is one suggested approach; other alternative approaches also may be appropriate.

Q25. When performing a forecast valuation for which the future year valuations use a prescribed mortality assumption, when is it appropriate to use a non-prescribed mortality assumption in the forecast?

A25. A forecast valuation involves the development of multiple valuations for multiple future years. This type of valuation uses two sets of assumptions, and the mortality assumption can be different for each set:

- Valuation Assumptions (which may use prescribed assumptions for funding calculations), and
- Forecast Assumptions.

In a forecast valuation, the participant data are rolled forward each year using the Forecast Assumptions. This is followed by a snap-shot valuation as of the future valuation date using the Valuation Assumptions. This two-step process is repeated throughout the study period. If the actuary believes the prescribed table is not the best estimate of the underlying mortality of the applicable population, then he or she may use a non-prescribed mortality table for the Forecast Assumptions. For the Valuation Assumption set, the actuary also may need to make an assumption as to the future prescribed assumptions.

Q26. What are some sample disclosures of a mortality table and mortality improvement assumption?

A26. The disclosure should be specific to the mortality table and mortality improvement assumptions used. Some examples follow. Note that these examples are for illustrative purposes only and are not standards or safe harbors.

Example A (generational table).

Mortality is assumed to be in accordance with the RP-2000 generational mortality table for males and females, with separate tables for annuitants and for disabled participants. As a generational table, it reflects mortality improvements in accordance with Scale AA both before and after the measurement date.

Example B (generational table with different scales before and after the measurement date, with language to limit the mortality improvement to "A" years beyond the measurement date)

Mortality Assumption—Mortality is assumed to be in accordance with the RP-20XX generational mortality table for males and females [add specifics, such as identifying the name of a table that is used for annuitants].

Mortality Improvement—Mortality is projected from the date of the table to the measurement date using Scale YY and beyond the measurement date using Scale ZZ, but for no more than A years.

Example C (combination of loaded table with static projection for a fixed number of years).

Mortality Assumption—Mortality is assumed to be in accordance with the GAM-20XX Static table for males and females.

Because table GAM-20XX is a loaded table, no adjustment has been made to reflect mortality improvements from the date of the table to the measurement date. 100 percent of Scale ZZ is used to project mortality rates beyond the measurement date for A years and 50 percent of Scale ZZ is used to project mortality rates from A years for B additional years beyond the measurement date. The resulting rates are used for all age cohorts.

Example D (combination of age setback with static projection).

Mortality Assumption—Mortality is assumed to be in accordance with the GAM-20XX Static table for males and females. To reflect mortality improvements since the date of the table, the male rates are set back three years and the female rates are set back two years. Scale ZZ is used to project mortality rates beyond the measurement date for 15 years for non-annuitants and eight years for annuitants. The resulting rates are used for all age cohorts.

Appendix 1

Current Mortality Tables
(2011)

The following is a summary of materials published by the various task forces and committees that were responsible for publishing the various tables. For more details on each table, the user should refer to the reports for each table.

Table Name: **The 1994 Uninsured Pensioner Mortality Table**

Table Location: The UP-94 Table report, including a discussion of the development and appropriate use of Scale AA (page 827), was issued in the 1995 Transactions of the Society of Actuaries (Volume 47) and can be found at this location:

> http://www.soa.org/library/research/transactions-of-society-of-actuaries/1990-95/1995/january/tsa95v4721.pdf

Purpose: Update UP-84 table.

Common Naming Conventions: UP-94, UP-94 @ YEAR (for table projected to YEAR (e.g.2008)), UP-94G (for a generational table), UP-94G @ YEAR (for generational table already projected to YEAR which will continue to be projected).

Data Used to Develop Table: Experience collected for this study was sufficiently close to insurance experience used for the GAR-94 Table so the same underlying data were used for both (see GAR-94, below).

Margins: None

Uses: Tool to develop a best estimate of mortality for a population under study, primarily for the use of actuaries of uninsured plans.

Table Name: The 1994 Uninsured Pensioner Mortality Table, Continued

Projection Scale: The factors for projecting mortality improvement beyond 1994 are based on the average of the CSRS and Social Security mortality improvement trends from 1977 to 1993, with a minimum of 0.5 percent for ages under 85, and are referred to as "Scale AA."

Rule of Thumb: The Task Force found that a static projection for *n* years, where *n* is the duration of the liabilities, is a very close approximation of the full generational table.

Relationship to Other Tables: The UP-94 Table is the same as the GAM-94 Table, except it excludes the 7 percent margin added (5 percent for random variation in mortality rates and 2 percent for other contingencies).

Unisex: The Task Force did not recommend the use of unisex factors for purposes of valuing pension plans.

As noted above, the UP-94, GAM-94, and GAR-94 tables are based on the same data. For a paper on issues in choosing among these tables see:

http://www.soa.org/library/research/transactions-of-society-of-actuaries/1990-95/1995/january/tsa95v4720.pdf

Table Names: **1994 Group Annuity Mortality Table and 1994 Group Annuity Reserving Table**

Table Location: The GAM-94 and GAR-94 Table report was issued in the 1995 Transactions of the Society of Actuaries (Volume 47) and can be found at this location:

http://www.soa.org/library/research/transactions-of-society-of-actuaries/1990-95/1995/january/tsa95v4722.pdf

Purpose: Update the Group Annuity Reserve Valuation Standard (previously based on GAM 83), incorporating generational mortality for the first time. Goal was to develop a table that would last for at least 15 years.

Common Naming Conventions: "GAM-94 Basic" (static, unloaded mortality table for calendar year 1994, Table 13 of TSA), "GAM-94 Static" (static, loaded mortality table for calendar year 1994, Table 18 of TSA), and GAR-94 (combination of GAM-94 Static and Scale AA).

Data Used to Develop Table: 1986–1990 data (insured annuitant experience from 11 large insurance companies for those at or over age 66 and the CSRS for those under age 66 and Actuarial Study No. 107 for under 25 and over 95), projected to 1994 based on CSRS experience from 1987 to 1993.

Margins in GAM-94 Static: 7 percent added (5 percent for random variation in mortality rates and 2 percent for other contingencies).

Uses: Determining reserves for insured group annuities.

Projection Scale: See UP-94, above.

Relationship to Other Tables: The GAM-94 Static Table is the same as the UP-94 Table, except it includes a 7 percent margin (see above).

As noted above, the UP-94 and GAR-94 tables are based on the same data. For a paper on issues in choosing between these tables see the following 1995 Transactions of the Society of Actuaries (Volume 47):

http://www.soa.org/library/research/transactions-of-society-of-actuaries/1990-95/1995/january/tsa95v4720.pdf

Table Name: **RP-2000 Mortality Tables**

Table Location: The RP-2000 Table report, supplemental report, and additional notes can be found at this location:

www.soa.org/research/experience-study/pension/research-rp-2000-mortality-tables.aspx

Purpose: To provide a suitable table for calculating Current Liabilities for single employer retirement programs following the Retirement Protection Act of 1994 (RPA).

Common Naming Conventions: RP-2000, RP-2000 projected to YEAR (for table projected to YEAR)

While the RP-2000 report did not suggest the same type of naming conventions as the UP-94 tables, the following would be appropriate:

- Table projected to a specific year without further projection: RP-2000@YEAR;
- The generational table: RP-2000G;
- Generational table already projected to a specific year with the projection continuing thereafter: RP-2000G@YEAR.

Data Used to Develop Table: Nearly 11 million life-years of exposure and more than 190,000 deaths, all from uninsured pension plans subject to RPA Current Liability rules. The experience is from more than 100 pension plans that submitted data for plan years 1990 through 1994. Data were projected to 2000 based on data from the Social Security Administration and Federal Office of Personnel Management.

Margins: None

Table Name: RP-2000 Mortality Tables Continued

Different Variations of Tables: Separate tables were developed by gender for employees, healthy annuitants (including retirees and beneficiaries), and disabled retirees. The study also looked at the effect of collar and size of annuity. Following is a brief discussion of factors to consider about these different variations:

- Employees vs. Annuitants—The report recommends separate tables be used for employees and annuitants.
- Healthy vs. Disabled Retirees—Use of the table for healthy annuitants may overstate liabilities if used for healthy and disabled retirees; the disability mortality table includes all disabled retirees, regardless of whether they are eligible for Social Security. Thus, it may not be appropriate if valuing a group of disabled participants with a different definition of disability.
- White vs. Blue vs. No Collar—Collar is a significant predictor of mortality in this data. Collar was set to blue if more than 70 percent of participants were hourly and/or union and to white if more than 70 percent of participants were salaried and/or non-union. All others were defined as mixed collar.
- Size of Annuity—Size of annuity is a significant predictor of mortality in these data. Small annuities were considered to be less than $6,000 per year and large to be more than $14,400 per year, with medium being between those two amounts. Note that some participants, such as terminated vested participants, have lower benefit amounts due to short service or other factors rather than due to income level. Also note that benefit levels tend to decrease in real value over time because few plans provide automatic cost-of-living adjustments.
- Combined Effect of Collar and Size of Annuity—there was no practical way to reflect both of these effects in the mortality tables.
- Other—Industry (SIC) code was not found to be a consistent predictor of mortality in these data.

Uses: Uninsured, single employer, private sector pension plans.

Projection Scale: Scale AA is recommended for projecting rates beyond 2000 (same table as is recommended for UP-94 and GAR-94).

Approximation: The Society of Actuaries' Committee on Retirement Plans Experience found that a static projection for *n* years, where *n* is the duration of the liabilities, is a very close approximation of the full generational table.

Table Name: RP-2000 Mortality Tables Continued

Relationship to Other Tables:[12] The GAM-83, GAR-94, and UP-94 tables (for annuitants) were developed by amount of annuity and not by number of lives. The RP-2000 Table was developed by amount of annuity, where available, and then the amount of annuity was estimated for those records providing only lives. In general, the RP-2000 annuity values are between 2 and 9 percent higher for males and between 3 and 5 percent lower for females than GAM-83. For males under 80, the RP-2000 values are within 4 percent of the UP-94 projected to 2000. For females, the RP-2000 values are 2 to 4 percent lower than UP-94 projected to 2000.

[12] Chapter 8 of "The RP-2000 Mortality Tables Report."

Appendix 2

Discussion of Mortality Credibility

This Appendix describes how theory can be used in setting mortality assumptions. It is extracted from an Academy letter to the IRS.[13]

Method I: Credibility Theory is a formal statistical theory developed by actuaries over the past century. While there are a variety of complex approaches, all ultimately produce a formula of the form: Z x plan's mortality + $(1 - Z)$ x standard mortality, where the larger the plan and its number of deaths, the greater the value of Z (even if the plan's mortality experience isn't significantly different than standard mortality). Under this theory or approach, *all* plans would have enough experience to *partially use* a substitute mortality table and some plans would have enough experience to *fully use* a substitute mortality table.

Thus, the above formula is used no matter how small the plan. A small plan would just have a small Z, and thus the substitute table would be quite close to the standard table. It is felt that, even in a small plan, the modified table would be better than if the standard table were used. If desired, there could be a cutoff for this method based on number of deaths, or size of Z-e.g., this method should not be used if Z is less than 0.25 or there are fewer than 100 deaths. A detailed discussion of this theory (with an example) is provided in the appendix.

Method II (Determining if there is a significant difference): Method II is an alternative approach which insurance actuaries inform us has also been used.[14]

A plan's actual number of deaths would be compared with the expected number of deaths using the standard mortality table projected to the calendar years being studied (or the central calendar year).

Classic statistical methods for assessing if something is significantly different from a standard start with a *null hypothesis* that they are the same, and an assessment whether that hypothesis can be disproved (with a minimal chance of error). In our case, we would set a null hypothesis that the mortality of the plan matches that of the standard mortality table, and test that hypothesis by comparing the actual number of deaths with the expected number of deaths. We would then use 'X' standard deviations to ascertain whether the difference is due merely to random fluctuation or due to the plan's mortality really being worse (or better) than the standard mortality table (i.e., we would decide to treat mortality differences as statistically significant if the ratio of actual to expected deaths exceeds (or is less than) 1 by more than a certain number of standard deviations). For example, if we used 1.645 standard deviations, for situations in which the plan's "true" mortality matches standard mortality, we *would incorrectly* say that the plan's

[13] Available at: http://www.actuary.org/pdf/pension/mortality_nov06.pdf.
[14] The use of Method I and Method II was confirmed by consultant Harvey Sobel, Principal and Consulting Actuary with Buck Consultants in Secaucus, NJ.

mortality experience is different from the standard mortality table only 5 percent of the time. (The 5 percent assumes that it made sense that the plan's mortality would be greater than (or less than) the standard table, but not both.[15]) If 1.96 standard deviations were used, we would be wrong only 2.5 percent of the time. An example is provided below.

Method II requires a certain amount of data to prove that the experience is significantly different from the standard table. For example, five years experience might be needed to get enough experience to satisfy this test for a smaller plan. For a very large plan, one year would be sufficient.

Method II Application: Once it was determined that the actual deaths are significantly different from the expected deaths, a mortality table could be developed in one of the following ways:

(1) By multiplying the standard mortality rates by the ratio of actual to expected deaths (and grading into q_x equal to 100 percent at age omega);
(2) By using the standard table with an age set back (or age set forward) so that the expected deaths are closer to the actual number of deaths. Fine-tuning could be achieved by multiplying it by the ratio of actual deaths to expected deaths under the set back (or set forward) table;
(3) By modifying the RP2000 blue-collar table (for appropriate blue-collar groups—i.e., not airline pilots or nurses) or the RP2000 white-collar table (for white-collar groups) by multiplying it by the ratio of actual to expected (determined using the appropriate collar table), as suggested in (1) above; or
(4) By creating a table directly from the experience q_x's at each quinquennial age (with graduation allowed, such that expected deaths equal actual deaths). This method might be used only with large plans in the controlled group, where one might consider requiring statistical testing at each quinquennial age grouping where this method is used (and one age grouping at the oldest and youngest ages where the data are sparse).

This mortality table would then be projected just as the standard table is projected.

Piecewise Determination: Large plans might have enough data to determine the ratios for different age groupings, for males and females separately, or for the annuitant and non-annuitant tables separately. In addition, we note that the RP2000 experience by collar became quite similar for people over age 80 (whether they had blue or white collar jobs, etc.[16]). Thus, the regulation could allow sponsors to analyze their experience just below age x (e.g., age 80), and then only apply the factor to ages below age x, and phase the modified table into the standard table from age x up to age x + 5, or x + 10.

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[15] If it was not obvious up front that the mortality would be worse (or better, in the case of say a white collar plan), then the two-sided test is used, which would mean we would be incorrect 10 percent of the time.

[16] See top paragraph on 6th page of Chapter 5 of the SOA's RPA2000 report (http://www.soa.org/files/pdf/rp00_mortalitytables.pdf) and the accompanying charts Figure 5-1 and Figure 5-5.

Standard Deviation: In order to use this method, the standard deviation would need to be determined. The distribution of deaths is the sum of many binomial distributions, so the mean is the actual number of deaths ($n \times q_x$), the variance is $n \times p_x \times q_x$, and the standard deviation is the square root of the variance.[17] Unless the number of deaths is very small (somewhat below 20), the central limit theorem tells us that the distribution can be approximated very well by the normal distribution.

Example: Assume that a sample population of 5,000 people has 100 expected deaths using the standard mortality table. Assume, as discussed in the prior section, that the variance is also 100, so the standard deviation is 10 deaths. Also assume that the actuary uses two standard deviations to test the null hypothesis. The actual deaths would have to be greater than 119.6 (100 + 10 x 1.96) or 20 percent different, in order to recognize that the plan's mortality was significantly different than the standard table's mortality.

If the sample population were larger by a factor of 100 (i.e., 500,000 people), the example would be as follows: Expected deaths would be 10,000 and the standard deviation would be 100 deaths. Actual deaths would have to be greater than 10,196 (10,000 + 100 x 1.96) or 2 percent different, in order to recognize that the plan's mortality was significantly different than the standard table's mortality.

Thus, a medium-sized plan would have to have a much greater difference in mortality rates in order to use its own experience. A large plan would not need as much difference in order to use its own experience.

[17] Note: the variance is quite close to the mean since p_x is very close to 1 (except at the oldest ages, which might be excluded anyway), so some practitioners may use the mean for the variance.

Notes: Credibility Theory[18]

There are two types of traditional credibility: greatest accuracy and limited fluctuation. Only the latter one will be discussed here. The key result of limited fluctuation credibility is that when a certain sample size is achieved the data can stand on its own (full credibility). The criterion for full credibility is that there is enough data so that the estimate of the mortality ratio (actual to expected deaths) will be within 100*h* percent of the true value Y percent of the time. The idea is that if there is enough data, it can be trusted because the answer can be relied upon. The required sample size is achieved if the standard deviation of the mortality ratio is less than h/z, where z is the appropriate percentile from the standard normal distribution (for example, for 90 percent confidence, set z equal to 1.645).

The variance of the mortality ratio can be estimated, where the q's can be from the data or from the standard table, the n's are the sample sizes at each age and e is the expected number of deaths. As a crude approximation, assume that the q's are nearly zero. Then the numerator is close to e and so the variance is $1/e$ (the actual number of deaths could also be used). So there is full credibility if $1/e < h^2/z^2$. As an example, suppose we required that the observed ratio be within 20 percent of the true ratio 95 percent of the time. Then the number of deaths must exceed $1.96^2/0.2^2 = 96$. Note that except for rounding, this matches the example presented earlier where 100 deaths implied that a 20 percent deviation is needed to be declared credible.

Should the observed number of deaths be less than the standard calculated, then the credibility formula uses Z = sqrt(observed deaths/required deaths). In the example from the previous paragraph, suppose there were 48 observed deaths. Then Z = sqrt(48/96) = 0.71 and the resulting table would be 71 percent of the experience plus 29 percent of the standard. Or, if the actual to expected ratio of deaths was, say, 1.2, then the table to use would be 0.71(1.2) + 0.29(1) = 1.142 times the mortality rates in the standard table.

Methods I and II are very different in application. In the example, with limited fluctuation credibility and using the given parameters (20 percent and 95 percent), any plan with 96 deaths would be entitled to stand alone as having credible mortality. This would be independent of the difference between the plan's experience and the standard table.

With the alternative method presented earlier, the ability to use plan experience depends on both the amount of data and the difference between experience and standard. There is nothing statistically more correct about one approach over the other. It depends on what form is desired for the solution.

[18] Stuart Klugman, Ph.D., FSA, and Professor of Actuarial Science Drake University provided these Notes.