Canadian Institute of Actuaries / Institut canadien des actuaires

*Educational Note – Second Revision*

# Selection of Mortality Assumptions for Pension Plan Actuarial Valuations

## Committee on Pension Plan Financial Reporting

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*Members should be familiar with educational notes. Educational notes describe but do not recommend practice in illustrative situations. They do not constitute standards of practice and are, therefore, not binding. They are, however, intended to illustrate the application (but not necessarily the only application) of the Standards of Practice, so there should be no conflict between them. They are intended to assist actuaries in applying standards of practice in respect of specific matters. Responsibility for the manner of application of standards of practice in specific circumstances remains that of the members.*

# MEMORANDUM

**To:** All Pension Practitioners

**From:** Faisal Siddiqi, Chair
Practice Council

Mark Mervyn, Chair
Committee on Pension Plan Financial Reporting

**Date:** December 21, 2017

**Subject:** **Educational Note – Second Revision: Selection of Mortality Assumptions for Pension Plan Actuarial Valuations**

This educational note is intended to assist actuaries in the selection of appropriate mortality assumptions for pension plan valuations. The focus is on establishing best estimate mortality assumptions suitable for use in going concern valuations for funding purposes and actuarial valuations for accounting purposes when the actuary expresses an opinion on the assumptions under the terms of engagement, under sections 3200 and 3400 of the Standards of Practice, respectively.

As outlined in subsection 1220 of the Standards of Practice, "The actuary should be familiar with relevant Educational Notes and other designated educational material." That subsection explains further that a "practice that the Educational Notes describe for a situation is not necessarily the only accepted practice for that situation and is not necessarily accepted actuarial practice for a different situation." As well, "Educational Notes are intended to illustrate the application (but not necessarily the only application) of the standards, so there should be no conflict between them."

This revised educational note has been published to take into account the recent publication of the Canadian Institute of Actuaries (CIA) final report on population mortality improvements as well as other industry developments in mortality. In September 2017, the CIA issued a final report on population mortality improvements (MI) prepared by the Task Force on Mortality Improvement, containing Canadian improvement scales based on experience studies conducted by the CIA and expert opinions. The primary objective of this study was to build mortality improvement scales that actuaries may use in both the insurance and pension practices for actuarial valuations for funding, reserving, and/or financial reporting purposes for a broad range of Canadian pension plans and life annuity products.

This educational note reflects both the 2017 CIA MI Study and 2014 CIA Canadian Pensioner Mortality (CPM) Study as well as other industry developments in mortality and replaces the previous educational note on the Selection of mortality assumptions for pension plan actuarial valuations issued on March 27, 2014.

In accordance with the Institute's Policy on Due Process for the Approval of Guidance Material other than Standards of Practice and Research Documents, this educational note has been prepared by the Committee on Pension Plan Financial Reporting and received final approval for distribution by the Practice Council on December 20, 2017.

Should you have any questions or comments regarding it, please contact Mark Mervyn at mark.mervyn@aonhewitt.com.

FS, MM

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## Selection of Mortality Assumptions for Pension Plan Actuarial Valuations

There is no one standard mortality assumption that would apply to all plans. The actuary would apply judgment in selecting a best estimate mortality assumption for the plan under review.

There are two key components to the selection of an appropriate best estimate mortality assumption:

- Base mortality table at the valuation date: the best estimate of the current rates of mortality for the plan; and
- Future mortality improvement scale: appropriate adjustments for future improvements in mortality.

The actuary would consider these two components separately in developing the assumption for future rates of mortality that would be appropriate at the valuation date.

### 1. Current Levels of Mortality

The first step in developing an appropriate best estimate mortality assumption is to determine the best estimate of the current levels of mortality. The best estimate would be developed considering the plan's actual plan mortality experience (where available), the credibility of such plan experience, the experience of similar plans, the experience of members with similar longevity characteristics (where available), published mortality studies, and possible adjustments based on individual member or plan characteristics such as collar type, industry, and pension size, and other socio-economic indicators that have been demonstrated to be correlated to mortality levels. If the best estimate of current levels of mortality is derived from an analysis of actual experience, appropriate adjustments would be made to project the mortality rates to the valuation date. The actuary may also consider adjusting the mortality rates of a published table if there is evidence that mortality improvements between the period of underlying data used in the development of the published mortality table and the valuation date are different from those assumed in the development of the published mortality table.

### 1.1 Credibility

In developing the best estimate of the current levels of mortality, a key consideration is the size of the plan and the amount of data available to the actuary. It is preferable to reflect actual credible experience of the plan under review, rather than to rely solely on published mortality studies or adjustments thereto. However, sufficient plan experience may not be available in all cases[1].

[1] For further information on credibility of mortality assumptions, see for example, appendix 2 of the American Academy of Actuaries October 2011 Public Policy Practice Note of Selecting and Documenting Mortality Assumptions for Pensions or, on the SOA website, Selecting Mortality Tables: A Credibility Approach (click on the link and then select the appropriate document from the list) by Gavin Benjamin,

- *Very large plans*
  For very large plans, say 10,000-plus retirees, experience studies would typically be prepared every three to five years. For these plans, mortality tables may be customized to reflect the experience of the specific plan using percentage adjustments to standard table mortality rates by age group and sex or, in cases where the data are sufficiently credible (typically involving significantly more than 10,000 retirees), by preparing plan-specific mortality tables.

- *Mid-size plans*
  Regular review of mortality experience is also valuable for mid-size plans, say 1,000 to 10,000 retirees. Although it is very unlikely the mortality experience would be assessed to be fully statistically credible, useful information may be derived and significant trends may be observed. Studies at this level may be used, after accounting for the credibility of the mortality experience, to select appropriate published mortality tables, develop broad adjustments to such tables (e.g., 90 percent or 110 percent of the standard table rates) or, in some cases, different adjustment factors may be used for a range of ages.

- *Small plans*
  For plans where the number of retirees is insufficient to conduct a credible mortality experience study, but where there are a significant number of retirees, say 100+, it is useful to examine the experience gain/loss related to pensioner mortality arising from past actuarial valuations. Such a review may give an indication of the validity of the mortality assumption and any strong trend in mortality experience.

- *Very small plans*
  For plans with few retirees, where there are not sufficient experience data, considerable judgment is required in selecting an appropriate mortality assumption. An appropriate published mortality table would be selected, adjusting for the characteristics of the plan, if warranted.

In instances where a plan's own mortality experience is not fully credible, consideration would also be given to the socio-economic indicators of the plan members, if credible data is available to the actuary for populations with comparable socio-economic indicators, as is more fully described in section 1.4 of this note.

### 1.2 Analysis of Mortality Experience

Important considerations in the analysis of mortality experience include the following:

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dated October 2008, or Credibility Educational Resource for Pension Actuaries Application of Credibility Theory to Mortality Assumption (https://www.soa.org/Files/static-pages/sections/pension/credibility-resource-pension.pdf).

- *Benefit amount vs. number of lives*
  In using experience studies to establish tables for actuarial valuation purposes, determining results weighted on benefit amount (or liability), rather than on number of lives, generally yields more appropriate results. Determining results weighted on benefit amount (or liability) may not be appropriate if a plan has frozen benefits (for example, those which have converted to a defined contribution plan for future service). Results based on number of lives may yield appropriate results for plans with flat dollar benefit formulas and/or with relatively homogenous characteristics.

- *Effect of base year*
  When assessing the implications of gain/loss experience it is important to consider the effect of any projections built into the mortality rates. Experience studies would align actual versus expected experience by properly adjusting for the base year of the projection. If future improvements in mortality are being reflected through the use of a fully generational table, no experience gain or loss implies that the table is representative of current experience. Whether the provision for future improvements in mortality is sufficient will be revealed in future gain/loss experience. If a valuation used a static mortality table—for example, projected 10 years into the future—no experience gain or loss on pensioner mortality implies that the valuation experience is already at the level expected in 10 years' time. If the experience is sufficiently credible, these results imply that all provisions for future mortality improvement have eroded and the table is out of date.

- *Basis of comparison*
  In comparing plan experience with a published mortality table, the analysis of the plan under review would mimic, to the greatest extent possible, the development of the published mortality table. For example, the 2014 CIA CPM Study determined mortality rates weighted on benefit amount and excluded surviving spouses. Therefore, it would be preferable if an analysis comparing plan experience to the tables provided in the 2014 CIA CPM Study used the same methodology.

- *Evolution of workforce longevity characteristics*
  In reviewing past plan experience, consideration would be given to the evolution of the plan's workforce characteristics over time. A plan's current pensioners represent a workforce from up to several decades in the past, and the longevity characteristics of this group may be markedly different from those of the current workforce.

### 1.3 Published Mortality Studies

Published mortality studies provide substantial information to assist the actuary in determining the best estimate of current levels of mortality, particularly if plan experience is not credible.

*The 2014 CIA CPM Study*

This study reviewed the experience of a number of Canadian registered pension plans, including both public sector and private sector plans, becoming the first broad experience study for Canadian pension plans. Based on the results of the study, the following mortality tables are provided:

- 2014 Mortality Table (CPM2014)—developed from the combined experience exhibited under the public and private sector plans included in the study;
- 2014 Public Sector Mortality Table (CPM2014Publ); and
- 2014 Private Sector Mortality Table (CPM2014Priv).

*New Information*

Research committees at the CIA and the Society of Actuaries (SOA) have mandates to monitor pension plan experience[2]. The actuary would consider recent trends and newly published data and research from these and other sources in developing the current best estimate levels of mortality. It would be preferable to use studies based on credible experience of Canadian pension plans rather than studies based on data from other countries. However, studies of data from the United States or other geographies comparable to Canada may provide relevant information and trends.

*Previous Studies*

Various mortality studies have been published over the years, including the 1994 Uninsured Pensioner Mortality Table (UP94), the 1994 Group Annuity Mortality Table (GAM94), and the RP-2000 Mortality Tables, along with the associated Scale AA improvement scale[3]. Based on the 2014 CIA CPM Study, current mortality rates for Canadian pension plan participants are on average significantly lower and exhibit a different pattern by age than the UP94, GAM94, or RP-2000 mortality rates projected forward using Scale AA. Therefore, at this time, use of the UP94, the GAM94, or the RP-2000 table, including Scale AA projections up to the valuation date, as a best estimate of current mortality rates would be appropriate only if supported by credible experience, the characteristics of the specific plan under review, or other quantifiable evidence.

*Relevance of Certain Mortality Studies*

In general, it would normally be inappropriate to use mortality tables derived from the following:

- General population experience for purposes of current levels of mortality for a pension plan actuarial valuation, because general population mortality experience

[2] In October 2014, the SOA's Retirement Plans Experience Committee (RPEC) published RP-2014 Mortality Tables Report and the Mortality Improvement Scale MP-2014 based on US private pension plan experience. RPEC has been regularly updating the improvement scale, with the most recent update published in October 2017, Mortality Improvement Scale MP-2017.

[3] *Transactions* of SOA, 1995, Vol. 47, and the RP-2000 Mortality Tables Study (SOA).

differs significantly from the subset of the population that participates in pension plans. However, general population tables, such as the Canada Life Tables, may provide information on geographical differences. An actuary may consider whether geographical distinctions merit reflection, given a plan's membership characteristics.

- Individual annuitant data, as mortality experience under individual annuity contracts tends to be lower than under pension plans due to anti-selection by the purchasers of individual annuities. The use of an individual annuity table may be appropriate for very small plans and, in particular, individual pension plans.

### 1.4 Adjustments for Plan Membership Characteristics

Important factors to consider in establishing a mortality assumption include the nature of employment and the relative amount of the pension payments. For example, published mortality studies clearly indicate that, other factors being equal, rates of mortality are greater

- For former blue collar workers than for former white collar workers;
- For former private sector workers than for former public sector workers; and
- For pensioners receiving small pensions than for pensioners receiving large pensions.

Data are presented in the published mortality studies[4] as to the extent of these effects and possible adjustments that may be applied to the base mortality table to allow for them. It is preferable to modify published tables to reflect actual, credible experience of the pension plan under review rather than applying data from published mortality studies to adjust for the above characteristics.

Adjusting for plan membership characteristics would not be required if

- The characteristics of the plan membership are not significantly different from the composite data used to prepare the published mortality table; and
- There is no credible plan experience which suggests that actual experience is different from the underlying base tables.

Adjustments for plan membership characteristics would also not be necessary for plans where the mortality rates are set based on fully credible experience weighted based on benefit amount or liability, as the impact of these characteristics would be implicit in the experience study results.

Adjustments to the published tables for plan membership characteristics would typically be considered if no credible experience is available for the plan and the attributes of the

[4] See for example, the 2014 CIA CPM Study, the Report of the Group Annuity Experience Committee, Mortality Experience for 2001–2002 (Society of Actuaries (SOA)) and the RP-2000 Mortality Tables Study (SOA).

plan are significantly different from the composite data used to prepare the published mortality table.

A brief commentary on the application of adjustments for plan membership characteristics is provided below.

*Private/Public Sector*

Relying solely on public or private sector employment as a determinant for mortality table selection without considering the underlying industry has practical limitations. For example, there may be subgroups within the public sector, such as blue collar-type workers, which do not exhibit experience comparable to the broader public sector. Judgment would be applied in selecting among tables based on sector.

*Collar Type*

Mortality experience analysis by collar type in broad-based experience studies may be restricted by the quality of the data available and the ability to classify it into collar types. The 2014 CIA CPM Study provided no specific experience by collar type. Some studies of US mortality have published such experience. However, the actuary would exercise care in combining collar experience in one study with overall experience in another as combining such experience may not yield satisfactory results due to underlying differences in the demographic profiles studied.

*Industry*

Mortality experience by industry may also be analyzed in conjunction with the preparation of broad-based experience studies. However, to date, industry analysis has not proven to be conclusive. In the RP-2000 study, industry codes were found not to be a consistent predictor of mortality. The 2014 CIA CPM Study found that there were not sufficient data to develop mortality tables by industry, but published actual-to-expected ratios (A/E ratios) by industry and age groups, though such ratios were not equally credible for all industries or for all age groups. Accordingly, industry information would be used with caution. An adjustment may be considered for a plan covering members in an industry which exhibits credible mortality experience that is significantly higher or lower than average. Larger, more homogeneous groups, such as university professors or teachers, will likely have more credible results in an industry experience study than smaller, diverse industries.

*Pension Size*

Adjustments for pension size may be applied either through size adjustments or through the use of separate mortality tables applicable to specified salary or pension amount bands[5]. The use of size adjustments is an emerging practice which may be considered where actual plan experience is not fully credible and industry adjustments are not

[5] The SOA's February 2014 RPEC exposure drafts of proposed RP-2014 mortality tables included tables for the first and fourth quartile of salary and pension amount bands.

available or are otherwise deemed inappropriate. Though size adjustments provide actuaries with a method of reflecting the correlation between pension amounts and mortality expectations, the actuary would be aware of the limitations of using size adjustment factors, and considerable judgment would be used when applying these factors or tables reflecting pension size. An adjustment would typically be considered when a plan has pension amounts or active members' earnings levels which are significantly higher or lower than the corresponding amounts underlying the base table for a selected published mortality study.

Use of pension size is a proxy for socio-economic status. The relationship between pension size and life expectancy is likely one of correlation rather than cause. Depending on the mobility of the plan membership, the pension amounts accrued under any one particular pension plan may be small relative to overall retirement income. Changes in plan design, such as closing or freezing plans, will result in smaller defined benefit pensions being paid from the plan over time, though these changes are unlikely to have a direct causal effect on a member's socio-economic status or life expectancy. The actuary would consider whether to reflect factors such as above-average mobility or below-average pension size due to plan design when adjusting for pension size. Relevant information that may be preferable to pension amounts includes pension amounts or liabilities per year of service or salary information.

Where the average size and distribution of pensions for the plan, after considering the mobility and plan design characteristics, are comparable to the average size and distribution of pensions reflected in the table for a selected published mortality study, the utility of adjusting for pension size would be limited.

If size adjustments are used, a satisfactory approach may be to determine a single weighted size adjustment factor for each gender using the average size adjustment factor weighted by pension amount[6]. The actuary would then select the associated published mortality table, differing by age and gender, with a percentage adjustment to mortality rates to approximate the effect of applying size adjustments.

Like experience studies, analysis of pension sizes would properly adjust for the base year of the projection and mimic the development of the published size factors. For example, when comparing the size of an actual indexed pension with the size of a pension in published tables, the indexation terms for the plan would be considered. As such, if and when pension size bands are adjusted for increases in wages, a fully indexed plan would have to adjust only for changes in the spread between the increase in average industrial wages and the level of indexation provided by the plan. For a non-indexed plan, it would often be appropriate to compare the pension payable to the pension size bands at time of retirement. Size adjustments would typically not be revised annually. However, if a

[6] See section 2.3.3 of the 2014 CIA CPM Study for details on how size adjustment factors would typically be applied.

mortality table assumption is revised, the effect on size adjustment factors would also be reviewed.

Typically, the same adjustments for pension size used for retirees would be applied to survivors. If no major shift in demographics has occurred or is anticipated, it is generally reasonable to also apply the same adjustments to active and deferred members as for retirees.

*Other Member-Level Socio-economic Indicators*

As discussed above, use of pension size is a proxy for socio-economic status. Where the actuary has credible mortality experience data available that is calibrated based on a factor that can be linked to socio-economic status, the use of these other member-level factors may be applied as proxies for socio-economic status. Examples of other factors which may correlate with socio-economic status include, but are not limited to, place of residence (i.e., postal code) and level of education.

*Combinations of Adjustments for Plan Membership Characteristics*

Caution would be used in deriving adjustments for variations in more than one plan characteristic (collar, industry, sector type, pension amount, and/or other socio-economic indicators) at the same time, as the combined effect may overstate or understate the actual relationship. A reasonable approach would be to consider adjustments to the published mortality table based on each characteristic separately. The alternative adjustments derived by considering each characteristic separately may be helpful in narrowing down a reasonable range and selecting a final assumption.

*Graduation of Rates*

After making adjustments to standard table mortality rates or preparing a plan-specific table, the rates in the resulting table may need to be smoothed so that they progress in a reasonable pattern from age to age. Graduation techniques may be useful for purposes of smoothing the mortality rates.

## 2. Adjustment for Future Improvements in Mortality

Improvements in mortality have occurred over most observed time periods and are expected to continue to occur for the foreseeable future. The analysis of mortality improvement rates requires large quantities of consistent data over long periods. As a result, most mortality improvement studies are based on data gathered through social security programs, and assumptions for future mortality improvements are normally based on mortality studies covering the general population, not just the subset of the population that participates in pension plans. Even then, assumptions in respect of future mortality improvement rates are subject to a high level of uncertainty and debate.

Development of a best estimate of future mortality improvement rates typically comprises three elements:

- A short-term rate based on recently observed improvement rates;

- An ultimate long-term improvement rate, which is highly uncertain; and
- A transition from the short-term to the ultimate improvement rates over a certain period and based on a particular pattern.

Such an approach results in improvement rates that vary by year, as well as by age, and could also reflect cohort effects whereby mortality improvement rates vary by year of birth.

There are three common methods of providing adjustments for future improvements in mortality:

- Two-dimensional (2-D) generational mortality scales;
- One-dimensional (1-D) generational mortality scales; and
- Static mortality scales with a fixed projection period.

Two-dimensional generational mortality scales, such as the CIA MI-2017 (MI-2017) and the CPM Improvement Scale B (CPM-B), allow for improvement rates that vary by year and age. MI-2017 was developed in 2017 using general population data from 1967–2015. CPM-B was developed based on the results of the C/QPP Phase III Report with some refinements, using data from 1967–2007. These both constitute broad and relevant mortality improvement studies for the Canadian population.

Given the recent publication of both scales and the similar data sets used in their development, it may be appropriate to use either scale in the absence of credible information to the contrary, such as the publication of a successor scale by the CIA.

For the MI-2017 scale, the CIA task force observed historical mortality improvement trends, expert opinions, and practices used in other regions to establish ultimate improvement rates and the period of transition from higher short-term improvement rates to the ultimate rates of improvements, while the CPM-B scale is based on experience from the C/QPP Study and assumptions used in the 26$^{th}$ Actuarial Report on the CPP. Given the uncertainty of the rates of future mortality improvements, the adoption of other 2-D scales with different initial and/or ultimate rates of improvement and periods and patterns of transition may also be appropriate when supported by a considered rationale.

One-dimensional generational mortality scales, such as the CPM Improvement Scale B1-2014 (CPM-B1D2014) or Scale AA, were commonly used in the past to allow for improvement rates that vary by age only. However, two-dimensional generational scales are more robust and are therefore generally preferred over one-dimensional scales. The CPM-B1D2014 scale was designed to be a reasonable substitute for using the CPM-B scale for valuations with effective dates in 2014 or 2015. The use of a 1-D scale may simplify calculations required under valuation systems and would be acceptable if it satisfactorily approximates the financial effect of an appropriate 2-D scale at the valuation date. The use of a 1-D scale may also be appropriate if the actuary believes that no transition is required; for example, if the actuary believes that ultimate mortality

improvement rates are not expected to differ from short-term mortality improvement rates.

Static mortality rates with a fixed projection period were commonly used in the past to approximate the effect of using generational scales. However, generational mortality scales are generally preferred, and with advances in technology, static table approximations are no longer necessary. If a fixed projection period is used, the actuary would consider the shortcomings of such an approach:

- Depending on the manner in which the fixed projection period is determined, the current service costs and/or the allocation of the actuarial liabilities by cohort or membership category may be inappropriate[7]; and
- The assumption will generally need to be updated at each subsequent valuation to reflect new base year mortality rates and revised projection periods to reflect any change in liability duration.

If the actuary nonetheless uses static mortality rates in lieu of an appropriate generational table, the actuary would ensure that the results are acceptable for the intended purpose of the work.

*Reviews of Mortality Improvement Rates*

The actuary would give consideration to emerging mortality improvement trends and studies on a regular basis, particularly those relevant to Canadian pensioners. When past improvements differ from expectations, base tables may have to be adjusted to current mortality levels. The actuary would consider whether future improvements are expected to differ from past trends. The adjustment for future improvements in mortality is normally considered separately from the current level of mortality.

## 3. Special Situations

### 3.1 Pre-retirement Mortality

Some published mortality studies, like the RP-2000 table, derive different rates for the pre-retirement and post-retirement periods. For the majority of Canadian pension plans, pre-retirement mortality assumptions are not of great significance to the calculation of actuarial liabilities, since

- Rates of mortality at pre-retirement ages are generally very low; and

[7] The report of the SOA UP-94 Task Force on the 1994 Uninsured Pensioner Mortality Table (Transactions of SOA 1995 Vol. 47) indicates that, in determining the liabilities of a plan, using a static table projected for a period equal to the duration of the liabilities using projection Scale AA was a close approximation to the use of a UP-94 generational table. This approach was not tested in conjunction with the 2014 CIA CPM Study. Regardless of the base table used, the actuary would note that the effective duration of projected benefit payments for current service cost calculations is generally much higher than the duration of projected benefit payments related to accrued actuarial liabilities, and that the duration of active member liabilities is generally higher than the duration of pensioner liabilities.

- In many cases, benefits payable on death are equal to the commuted value of a deferred pension entitlement.

Therefore, less rigour is typically required in the selection of the pre-retirement mortality assumption, and use of the same assumption as for post-retirement mortality will generally be satisfactory. However, the actuary would give greater consideration to the selection of the pre-retirement mortality assumption in particular cases where:

- Benefits payable on member death are significantly different from the commuted value of accrued pensions; and/or
- Actual observed rates of mortality for active members are significantly different from those expected based on the standard mortality tables.

In the case of a very small plan, it may be reasonable to assume no mortality before retirement, particularly if the death benefits are equal to the commuted value.

### 3.2 Disabled Life Mortality

Published mortality study data identify that higher mortality is experienced by individuals who were disabled prior to retirement compared to individuals who were not disabled prior to retirement. Where data are available and the characteristics of the plan warrant, use of a separate mortality assumption for those members who were disabled prior to retirement may be considered. Where a separate table is used for members who were disabled prior to retirement, the assumed mortality rates for other retired members may be adjusted to reflect the fact that standard mortality tables typically reflect the combined expected rates of mortality for all retired members, including those who were disabled prior to retirement.

## 4. Sensitivity

The actuary may disclose sensitivity information with respect to changes to the mortality assumption, depending on the terms of engagement or the intended purposes of the work. Possible sensitivity disclosures include the following:

- The change in the current service cost or normal actuarial cost.
- The change in the actuarial liabilities, accounting obligations, or present value of accrued benefits.

Two possible approaches to measuring the sensitivity of the disclosure item to changes to the mortality assumption are

- The impact of the life expectancy of members being one year higher than assumed. An age setback could be used to estimate the effect of increased life expectancy.
- The impact of a percentage adjustment to mortality rates. For example, the effect of decreasing mortality rates at all ages by 10 percent may be disclosed.

If this approach is taken, the effect on the resulting life expectancy could also be disclosed.

Other approaches for measuring mortality sensitivity may also be reasonable.

Sensitivity to long-term improvement rates may be gauged by altering the ultimate long-term rate and adjusting the transition between the short-term and long-term rates in a manner consistent with the underlying published mortality study.

## 5. Application

### 5.1 Use of Pension Mortality Assumptions for Other Purposes

Often the mortality assumptions used for a pension plan are extended to other actuarial valuations for accounting purposes, notably for post-retirement benefits other than pension and executive compensation disclosures. The selection of best estimate mortality assumptions suitable for these other valuations is beyond the scope of this educational note. However, in selecting or recommending a best estimate mortality assumption for these other purposes, the actuary would consider whether different plan provisions, membership data, and liability structures would necessitate alternate assumptions or approximations.

### 5.2 New Experience Studies

In determining how an experience study or other new information affects a valuation, an actuary would refer to the Standards of Practice.

The publication of a mortality experience study is an example of a subsequent event that provides information about an entity as it was at the calculation date[8]. Therefore, if such a study is published after the calculation date but before the report date, which "would usually be the date at which the actuary has substantially completed the work"[9], the actuary would take into account the new information available in establishing the mortality assumption[10].

If an actuary has already prepared a valuation report with a calculation date before the publication of an experience study, the actuary would consider paragraphs 1820.30 through 1820.36 of the Standards of Practice to determine whether it is necessary to withdraw or amend the report.

### 5.3 Applicability

This educational note provides guidance on principles for the selection of best estimate mortality assumptions. It is not intended to preclude the application of judgment in the selection of the actual mortality assumption to be used in a going concern valuation, which may include the use of reasonable approximations.

Under the Standards of Practice, the actuary would select independently reasonable assumptions. The requirement for independently reasonable assumptions would not

[8] Paragraph 1520.07 of the Canadian Institute of Actuaries Standards of Practice.
[9] Ibid., 1820.31.
[10] Ibid., 1520.02.

require a test of reasonableness within an assumption. For example, a mortality assumption would need to be reasonable only as an independent assumption in total, even though there may be offsets within the assumption[11]. The actuary may strike a balance between complexity needed for reasonable representation of reality, simplicity of calculations, and materiality.

[11] Ibid., 1720.03.1 and 2.