Seeing Beyond Risk

Canadian Institute of Actuaries / Institut canadien des actuaires

Voir au-delà du risque

Final Report

Canadian Pensioners' Mortality

Pension Experience Subcommittee – Research Committee

February 2014

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Seeing Beyond Risk Canadian Institute of Actuaries Institut canadien des actuaires Voir au-delà du risque

Memorandum

To: All Fellows, Affiliates, Associates, and Correspondents of the Canadian Institute of Actuaries

From: Marc Tardif, Chair
Member Services Council

Dave Dickson, Chair
Research Committee

A. Kim Young, Chair
Pension Experience Subcommittee

Date: February 13, 2014

Subject: **Final Report: Canadian Pensioners' Mortality**

On behalf of the Pension Experience Subcommittee, the attached document contains Canadian pensioners mortality tables and improvement scales based on experience studies conducted by the Canadian Institute of Actuaries. There are a number of documents and tables referenced in this document that are available online; links are provided at the applicable reference points.

The primary objective of these studies was to build base mortality tables and mortality improvement scales that may be used for actuarial valuations for funding and/or financial reporting purposes for a broad range of Canadian pension plans. Furthermore, it is expected that such tables and scales may be considered for use under actuarial standards of practice for the determination of pension commuted values and the division of pension benefits on marriage breakdown.

The subcommittee's role has been to manage and assess the experience study analyses and to present proposed tables for consideration by Institute members and other stakeholders.

It is anticipated that the Committee on Pension Plan Financial Reporting will be updating the educational note guidance regarding the selection of mortality assumptions following publication of this report. In addition, the Actuarial Standards Board has established a project to consider promulgation of revised mortality tables for the pension commuted value standard and the standard for capitalized value of pension plan benefits for a marriage breakdown.

MT, DD, AKY

360 Albert Street, Suite 1740, Ottawa ON K1R 7X7
613.236.8196 613.233.4552
head.office@cia-ica.ca / siege.social@cia-ica.ca
www.cia-ica.ca

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EXECUTIVE SUMMARY

The actuarial valuation of pension plans in Canada has often incorporated the use of, or reference to, the mortality experience of group annuity contracts and pension plans largely resident in the United States due to a lack of Canadian pension plan experience data. In 2008, the Canadian Institute of Actuaries embarked on a review of Canadian mortality experience to assess the continued validity of this practice.

This Canadian Pensioners Mortality Report presents the findings of a review of a subset of Canadian registered pension plans (RPP Study) in conjunction with a separate review of mortality experienced under the Canada Pension Plan and the Québec Pension Plan (C/QPP Study). These reviews show that Canadian mortality experience is different from the United States experience that has often been referenced to value Canadian pension plans and that the development of Canadian-based mortality tables and mortality improvement scales is warranted.

This report presents gender-specific mortality tables based on the overall RPP Study data and separate tables based on public and private sector data. In addition, size adjustment factors that reflect mortality differences observed by pension income levels are provided. Limited information is also provided to identify the potential mortality differences that exist for the industries represented in the RPP Study data.

This report also presents both a two-dimensional mortality improvement scale and a transitional one-dimensional scale that approximates, in the near term, the financial effect of the two-dimensional scale. The mortality improvement scales are based on experience from the C/QPP Study and assumptions used in 26th CPP Actuarial Report.

The results included in this report are directly applicable to Canadian pension plans. The results may not be reflective of the mortality and life expectancies inherent in the Canadian population in general and should be used with caution in that context.

The release of this final report follows a period of consultation on the Draft Report for Comments, Canadian Pensioners' Mortality published on July 31, 2013 (Draft Report). It is important to note that the mortality tables and improvement scales provided with this final report supersede those provided with the Draft Report. To avoid confusion, the mortality tables and improvement scales in this report are named differently from those in the Draft Report.

All comments received on the Draft Report were given due consideration. A summary of the comments received is provided in section 5 of this report along with the most significant implications for the results presented in this final report. The following are noted in particular:

- The mortality tables in the final report are developed using a slightly larger RPP data set and with an allocation by industry for a high proportion of the data;
- The mortality tables in the final report were derived after modifying the RPP Study data to reflect weightings by industry derived from CANSIM data regarding pension plan membership;
- The assumptions for the ultimate mortality improvement rates (applicable from 2030) have been updated to coincide with the assumptions used in the recently published 26th CPP Actuarial Report and to extend non-zero improvement rates to very high ages.

INTRODUCTION

In 2008, the Research Committee of the Canadian Institute of Actuaries (Institute) formed the Pension Experience Subcommittee to:

- Review pensioner mortality experience in Canada; and
- Develop and maintain Canadian pension mortality tables and improvement scales.

To this end, the Institute commissioned two experience studies. The C/QPP Study reviewed the experience of pensioners under the Canada Pension Plan, the Québec Pension Plan, and in combination. For the purpose of developing mortality tables, the C/QPP Study reviewed the mortality experience of all persons receiving a retirement pension from the CPP and QPP for the calendar years 2005, 2006, and 2007 (central year 2006). The complete results of this study are provided in a report prepared by Louis Adam, FCIA, FSA, entitled "The Canadian Pensioners Mortality Table, Information on mortality for the triennial period ending December 31, 2007, with data as at December 31, 2008" (the C/QPP Phase II Report), which can be found here.

The C/QPP Study also reviewed the trends of mortality experience since 1967, the first year that pensions became payable under these programs. Results of this study are provided in the report, also prepared by Louis Adam, entitled "The Canadian Pensioners Mortality Table, Historical Trends in Mortality Improvement and a Proposed Projection Model based on CPP/QPP data as at December 31, 2007" (the C/QPP Phase III Report), which can be found here.

The second study, the RPP Study, reviewed the experience of a number of Canadian registered pension plans, including both public sector and private sector plans. The results of this study are provided within this report. For this purpose, the Institute commissioned MIB Solutions to gather data from Canadian pension plan contributors on lives covered by their pension plans. Following their data collection and validation processes, MIB Solutions provided Bob Howard, a member of the Institute and the subcommittee, with seriatim records derived from the data submitted.

All further analyses and table construction for the RPP Study were prepared by Mr. Howard in accordance with the scope and methodology approved by the subcommittee. This included Mr. Howard seeking and obtaining improved data and sign-offs from some data contributors.

The primary objective of these studies was to build base mortality tables and mortality improvement scales that may be used for actuarial valuations for funding and/or financial reporting purposes for a broad range of Canadian pension plans. Furthermore, it was expected that such tables and scales may be considered for use under actuarial standards of practice for the determination of pension commuted values and the division of pension benefits on marriage breakdown.

This report presents a set of mortality tables based primarily on the experience observed from the RPP Study and mortality improvement scales based on the experience observed from the C/QPP Study and assumptions used in the 26th CPP Actuarial Report. The subcommittee notes that the tables reflect the experience of the data submitted. Actuaries should exercise judgment in their use of the tables. Adjustments to the published tables may be appropriate in many circumstances.

The Institute thanks the 19 administrators/record-keepers (contributors) for contributing data and providing ongoing clarification to the subcommittee. The Institute appreciates the considerable effort expended by the contributors.

The Institute also thanks those members and non-members of the Institute who have dedicated significant time to this work as current and past participants of the subcommittee. In particular, the Institute thanks Louis Adam, Bob Howard, and MIB Solutions for the data compilation and analyses prepared on behalf of the Institute.

The members of the Pension Experience Subcommittee as at February 2014 are: A. Kim Young (Chair), Louis Adam, Michael Banks, Gavin Benjamin, Assia Billig, Paul Burnell, Bob Howard, Hrvoje Lakota, Scott McManus, and Catherine Robertson.

1 MORTALITY TABLES AND MORTALITY IMPROVEMENT SCALES

1.1 Mortality Tables

1.1.1 Base Tables

In the RPP Study, the mortality experience for calendar years 1999 to 2008 of a subset of Canadian public sector and private sector registered pension plans was reviewed. Based on the results of the RPP Study, the following base male and female mortality tables for the year 2014 are provided:

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

The abbreviation "CPM" that refers to Canadian pensioners' mortality prefaced the table names adopted under the C/QPP Study and in the Draft Report. The table names presented here reflect the adoption of the final tables resulting from the two experience studies.

The final mortality tables for the year 2014 can be found here. Sample rates are provided in appendix 1. As requested by a number of the members of the Institute, tables in respect of each of the years 1999 to 2013 have also been prepared, and can be found here.

1.1.2 Industry Experience

As part of the RPP Study, the subcommittee reviewed the mortality experience by industry. Generally, there are insufficient data to develop mortality tables by industry. However, data on actual to expected (A/E) ratios, relative to the CPM tables, by industry may be useful to actuaries where specific plan experience or similar plan experience is not available. These data are provided in appendix 2.

1.1.3 Blue, White, and Mixed Collar Considerations

Very little study data included collar type. The subcommittee made an attempt to classify the RPP Study data into blue collar, white collar, and mixed based on industry. However, this analysis did not yield satisfactory results and therefore no specific experience by collar type is provided in this report.

1.1.4 Size Adjustment Factors

The RPP Study, and the C/QPP Study, identified significant experience variation by size of pension. Accordingly the subcommittee developed size adjustment factors that can be used with

the base mortality tables. Size adjustment factors for each mortality table are posted on the same worksheet as the table, and can be found here. The rates are also shown in appendix 1.

1.1.5 Application

It is expected that practitioners will adopt a table that is most reasonable and appropriate in the circumstances of the particular plan under review. The subcommittee believes that it is best practice to consider whether modifications to the base tables are appropriate to reflect actual, credible experience of the pension plan under review. If lacking fully-credible experience, the subcommittee suggests that the actuary might consider using experience from other similar plans, the RPP Study size adjustment factors, and/or industry data for adjusting the base table.

Considerations for the use of size adjustments are discussed in section 2.3.

The subcommittee notes that the composite 2014 Mortality Table represents the experience of all registered pension plans included in the RPP Study, with adjustments to reflect the overall distribution of Canadian pension plan membership by industry, and suggests that it could be considered suitable for use under actuarial standards of practice for the determination of pension commuted values and for the division of pension benefits on marriage breakdown.

1.2 Mortality Improvement Scales

1.2.1 Introduction

The C/QPP Study reviewed the trends of mortality experience since 1967, the first year that pensions became payable under those programs. Based on the results of the C/QPP Study, the following male and female improvement scales are provided:

- CPM Improvement Scale B (CPM-B)—improvement rates by age that decrease in a linear fashion for years 2012–2030 and ultimate rates applicable for all years after 2030; and
- CPM Improvement Scale B1-2014 (CPM-B1D2014)—improvement rates by age only designed to approximate the CPM Improvement Scale B for pension valuations in 2014 and 2015.

These improvement scales can be found online here. Sample rates are provided in appendix 1.

1.2.2 Application

The subcommittee proposes that practitioners consider adopting the two-dimensional mortality improvement scale, CPM-B. However, the subcommittee recognizes that some pension valuation and administration systems may not currently accommodate a two-dimensional scale.

Based on these considerations, the subcommittee also developed the transitional, one-dimensional (age only), gender-specific mortality improvement scale, CPM-B1D2014, that approximates in the near term the financial effect of the two-dimensional scale, assuming both sets of rates are applied on a generational basis.

For each age, the mortality improvement rates developed for the one-dimensional scale take into account the evolution of improvement rates anticipated over the next several decades. The two-dimensional scale assumes a slowdown in mortality improvement after 2014 compared to earlier years. As such, it may be inappropriate to apply the one-dimensional scale for the purpose of actuarial valuations after 2016 since it may result in an overstatement of actuarial liabilities.

It would be valid to use the CPM-B scale for valuations where the base table has been adjusted for mortality improvement or experience to 1999 or a later year. CPM-B would then be applied from that particular year. However, the one-dimensional scale CPM-B1D2014 is suitable for use only with a table that has been adjusted for mortality improvement or experience to 2014.

To clarify the use of the two-dimensional improvement scale developed under this study, consider the data in table 1 for the following example:

Table 1. Example of using 2-dimensional improvement scale

Subset of CPM Improvement Scale B				Subset of CPM2014	
Male	2014	2015	2016	Age	Male
80	0.02653	0.02537	0.02421	80	0.03981
81	0.02484	0.02379	0.02274	81	0.04522
82	0.02316	0.02221	0.02126	82	0.05144

Suppose it is desired to calculate the probability at the start of 2015 for a male then age 80 to survive for two years. In the notation below, "*I*" represents the improvement rate and a superscript is the year for the mortality rate or improvement rate, where the base year is 2014.

$${}_2p_{80}^{2015} = p_{80}^{2015}p_{81}^{2016} = (1 - q_{80}^{base}(1 - I_{80}^{2015}))\,(1 - q_{81}^{base}(1 - I_{81}^{2015})\,(1 - I_{81}^{2016}))$$

= [1-0.03981*(1-0.02537)]*[1-0.04522*(1-0.02379)*(1-0.02274)]

= 0.919733

Notation for mortality rates and improvement rates by year does not appear to be standardized within the profession. The subcommittee uses the following definitions, which incidentally were also used by the Society of Actuaries in connection with the two-dimensional Scale BB.

q_x^y means the probability that a person, age *x* nearest birthday at the beginning of calendar year *y*, will die before reaching the end of the calendar year. Note that both *x* and *y* are defined at the beginning of the one-year period.

I_x^y means the improvement rate in mortality for persons aged *x* nearest birthday at the start of calendar year *y*-1 to those aged *x* at the start of calendar year *y*. In this case *x* is constant through the one-year period, and *y* is defined at the end of the period.

$$q_x^y = q_x^{y-1}(1 - I_x^y)$$

2 DEVELOPMENT OF MORTALITY TABLES AND SIZE ADJUSTMENT FACTORS

2.1 Data—RPP Study

2.1.1 Data Gathering

The Institute commissioned MIB Solutions to gather data from Canadian pension plan contributors on lives covered by their pension plans. The call for data went out in November 2009, and data were collected during 2010. Nineteen contributors submitted data for calendar years 1999 to 2008, from both the public and private sectors, for active lives, for pensioners and

for beneficiaries after the death of pensioners. Not all contributors provided data for all years and one contributor subsequently withdrew from the study.

The data collection and validation processes are described in the MIB Solutions report, which can be found online here.

MIB Solutions provided Bob Howard, a member of the Institute and the subcommittee, with seriatim records derived from the data submitted. In particular, to protect confidentiality, member identification numbers were removed, company and plan names were replaced by codes, and dates of birth and death were replaced by age and year of death. Codes were added to indicate the status as active, pensioner, or beneficiary, whether excluded, and whether unresolved. A record is marked unresolved if there was exposure for that life in some years but not in later years and no death was reported.

To ensure that the data transmitted to and assembled by Bob Howard remained consistent with that provided by MIB Solutions, the MIB Solutions report includes a table of ungraduated mortality rates based on preliminary public sector pensioner data. A comparison of those rates to similarly calculated rates prepared by Mr. Howard confirmed for the subcommittee that he and MIB Solutions were using the data in an appropriate and consistent manner.

2.1.2 Data Selection and Modification

Not all data submitted by contributors were of uniformly high quality. Individual records were excluded if they had been flagged by MIB Solutions as excluded. If a record was marked as unresolved, all records for that life were excluded.

Not all contributors provided sign-off to MIB Solutions indicating their agreement that the data were sufficiently accurate. Subsequent to receiving the data from MIB Solutions, the subcommittee approached five contributors who had not signed off. One of these withdrew its data because a summary of its data was not consistent with its internal mortality study. The other four contributors provided sign-off, and two of those provided revised data before sign-off.

The RPP Study used data only if the relevant contributor signed off. In the end, the data from 13 contributors were used for the RPP Study.

It was necessary to exclude some contributor-years of data. All records for a contributor were rejected for a particular year if any of the following criteria were met:

- Unresolved records exceeded 10% of the number of deaths in the year;
- The A/E ratio based on annualized pension was an outlier by more than three standard deviations; or
- The number of deaths in the year was less than 20.

For one contributor, which submitted data for all 10 years, there were so many unresolved records for the first five years of data that the subcommittee initially rejected those years of data. After examining a sample of 20 unresolved records for pensioners, it was found that all had died and 19 of them had died in the last year that the pensioner had been included in the data (but marked as alive). Therefore, for this contributor only, all unresolved records were treated as deaths in the last year reported alive and all 10 years of data were included.

It was concluded that the active life data were not sufficiently reliable for the purpose of constructing a table. Salaries were available for such a small proportion of the data that the salary information was not usable. A non-zero salary on death records was rare. The A/E death ratios

by number of lives were very low at the younger ages and very high at the older ages, so much so that the accuracy of the active death records was in question. Furthermore, it was the subcommittee's view that the mortality rates for active lives are typically less relevant in the context of pension valuations.

The subcommittee also concluded that the beneficiary data should not be used in table construction. It would be appropriate to include beneficiary data only if the study could also include experience for these lives prior to the death of the member, but such experience was not available.

In contrast to the RPP Study, the Institute's Individual Annuitant Mortality Study tracks both lives from the outset of a joint and survivor annuity. That experience shows that mortality is lighter than for single lives while both are alive, but substantially higher after the first death. A test on that data showed that the present value of a joint and survivor annuity would be essentially the same whether calculated based on single life mortality throughout or on "joint both alive" mortality until the first death and on "joint survivor" thereafter. These observations gave the subcommittee confidence in relying on the member pensioner data only to give a satisfactory result. The subcommittee concluded that including the beneficiary data would bias mortality rates upward.

All pensioner records with a monthly income of less than $10 were excluded. A surprisingly large number of records included pensions with very low or zero income. It is not clear how there can be a pension with a zero monthly benefit; those records were considered to be unreliable. If the income is very small, there is less incentive for the contributor to seek information on the pensioner, and a death is more likely to go unreported.

The monthly income for any one record was capped at $10,000; any excess is ignored. There are a few records with very large pension amounts. Without capping the monthly income, these very large records could have too strong an influence on the experience measured by income, and their presence at the least increases the variability of the experience. The cap of $10,000 is anticipated to be high enough to capture virtually all of the amounts payable under registered pension plans.

There are codes to indicate the form of benefit (e.g., life only, joint, and survivor, etc.). It would have been desirable to study experience separately for each type. However, so many contributors reported the form as "unknown" that distinction by form of payment was abandoned.

It is also important to note, based on the location of contributors participating in the RPP Study, that pensioners included are primarily located in the provinces of British Columbia, Nova Scotia, and Ontario.

2.1.3 Data Summaries—Before Industry Weighting

Table 2 shows the data for pensioners as submitted by participating contributors and a summary for each deduction: for not signed off, excluded (as flagged by MIB), unresolved (records missing with no death reported), rejected (contributor-year of data meets one of the three criteria mentioned above related to questionable data), for small incomes (under $10 per month), and for excess incomes (over $10,000 per month). "Included" refers to the data used in the RPP Study. Data for the public and private sectors are shown separately.

In all tables, "count" means the number of life-years included, and "pension" is the sum of the annualized pensions over those same life-years. [Note: in the tables provided in this report, sums may not add exactly due to the rounding of intermediate amounts.]

Table 2. Summary of data for Pensioners				
Public Sector				
	Exposed		Deaths	
	Count	Pension	Count	Pension
Submitted	5,152,184	107,173,848,575	99,299	1,400,807,796
Not signed off	2,060,368	39,524,681,937	38,176	464,961,117
Excluded	9,213	82,473,466	200	699,909
Unresolved	4,061	86,896,439	0	0
Rejected	389,127	6,907,378,095	5,997	27,889,458
Small	4,858	91,312	142	1,510
Excess	0	0	0	0
Included	2,684,556	60,572,327,326	54,784	907,255,803
Private Sector				
	Exposed		Deaths	
	Count	Pension	Count	Pension
Submitted	976,751	10,528,559,182	47,999	374,297,590
Not signed off	0	0	0	0
Excluded	159	657,727	289	1,235,856
Unresolved	6	15	0	0
Rejected	13	220,112	0	0
Small	13,674	907,979	872	58,821
Excess	0	7,238,268	0	127,145
Included	962,899	10,519,535,081	46,838	372,875,769
Total Included	3,647,455	71,091,862,407	101,622	1,280,131,572

Table 3 shows the data included in the RPP Study for each year of experience. The average year of experience, weighted by income exposed, is 2004.39.

Table 3. Data by year for Pensioners

Public Sector				
	Exposed		Deaths	
Year	Count	Pension	Count	Pension
1999	165,692	3,347,669,395	3,713	52,647,662
2000	175,702	3,681,953,478	3,853	57,544,931
2001	186,443	4,081,910,146	3,786	59,480,166
2002	211,040	4,842,741,328	4,347	73,981,647
2003	224,464	5,259,922,839	4,289	72,910,072
2004	316,632	6,923,599,845	6,312	102,134,734
2005	330,716	7,389,891,130	6,795	110,404,228
2006	344,318	7,879,329,714	7,001	118,701,848
2007	357,680	8,327,830,024	7,241	124,803,514
2008	371,869	8,837,479,427	7,448	134,647,001
Public	2,684,556	60,572,327,326	54,784	907,255,803
Private Sector				
	Exposed		Deaths	
Year	Count	Pension	Count	Pension
1999	68,296	677,448,921	3,359	24,354,502
2000	70,691	715,574,113	3,235	24,678,150
2001	69,462	745,686,597	3,250	24,898,118
2002	75,396	841,013,967	3,422	29,083,812
2003	112,276	1,050,926,699	4,807	34,848,323
2004	110,686	1,075,787,080	5,634	42,366,218
2005	108,174	1,090,139,012	5,528	41,819,863
2006	116,903	1,380,936,097	5,940	49,140,694
2007	115,584	1,439,076,067	5,863	50,265,205
2008	115,432	1,502,946,528	5,800	51,420,884
Private	962,899	10,519,535,081	46,838	372,875,769
Total	3,647,455	71,091,862,407	101,622	1,280,131,572

Tables 4 and 5 show the data included in the RPP Study by gender. The A/E ratios, particularly by pension, show that UP-94 mortality rates projected with Scale AA to 2004 (UP94@2004) are significantly higher than experienced at most ages. Perhaps more significant is the fact that the slope of the experience is materially different from the slope of UP94@2004.

Table 4. Experience by quinquennial age groups for Male pensioners

Male	Exposed		Deaths		A/E on UP94@2004	
Ages	Count	Pension	Count	Pension	Count	Pension
< 55	33,545	1,096,938,778	232	4,811,645	230.1%	140.7%
55-59	217,141	7,724,077,665	1,107	31,990,960	95.5%	77.5%
60-64	316,662	10,277,691,426	2,616	70,371,196	86.2%	72.2%
65-69	353,214	7,736,597,633	4,992	91,123,702	83.6%	70.2%
70-74	336,255	5,990,959,315	8,316	125,304,726	93.4%	79.6%
75-79	298,462	4,482,083,265	12,846	170,490,828	100.1%	89.1%
80-84	207,556	2,705,401,398	15,125	177,732,558	99.4%	90.1%
85-89	100,816	1,154,109,504	12,217	131,314,501	106.0%	100.0%
90-94	31,399	328,417,912	6,156	61,598,400	108.4%	103.9%
95-99	5,314	50,896,389	1,521	14,348,471	106.4%	104.9%
> 99	560	5,077,034	171	1,745,787	83.1%	94.6%
All ages	1,900,924	41,552,250,320	65,300	880,832,774	98.8%	86.0%

Table 5. Experience by quinquennial age groups for Female pensioners

Female	Exposed		Deaths		A/E on UP94@2004	
Ages	Count	Pension	Count	Pension	Count	Pension
< 55	45,840	1,282,701,558	306	6,299,508	391.9%	276.6%
55-59	258,017	6,983,598,770	851	21,234,889	104.1%	96.4%
60-64	361,126	8,248,377,036	1,627	33,357,410	74.4%	67.8%
65-69	341,748	5,012,837,259	2,663	38,962,281	71.9%	72.2%
70-74	256,620	3,163,239,997	3,529	39,667,365	82.0%	75.2%
75-79	199,789	2,104,171,457	4,902	46,490,183	86.6%	78.6%
80-84	147,405	1,382,499,840	6,758	58,741,173	93.6%	86.9%
85-89	87,720	841,730,524	7,376	67,307,611	99.1%	93.9%
90-94	37,558	397,899,487	5,653	57,509,139	104.9%	100.3%
95-99	9,537	109,101,661	2,246	25,042,122	106.6%	103.8%
> 99	1,173	13,454,499	410	4,687,118	107.9%	108.3%
All ages	1,746,531	29,539,612,088	36,322	399,298,798	92.5%	86.0%

Data comparable to that shown in tables 4 and 5, with A/E ratios relative to relevant CPM mortality tables, are provided for the public sector, the private sector, and for each industry identified in the RPP Study in the workbook referenced in appendix 2.

2.1.4 Incurred But Not Reported (IBNR)

It is probable that the data submitted miss some deaths that have occurred but were not yet reported at the time the data were submitted, referred to as incurred but not reported (IBNR) deaths. Since the most recent data are certain to have more IBNR deaths than the data for earlier years, it is important to adjust for IBNR before trying to infer the extent of improvement in mortality. This adjustment, although important, is highly subjective. The subcommittee has no pension-related information on which IBNR factors can be determined. The subcommittee used the IBNR factors of the Institute's Individual Annuitant Mortality Study as a starting point. However, it must be noted that the IBNR factors vary considerably by company, gender, duration, and form of benefit.

Since data were contributed in 2010 with 2008 as the last year of experience, it made sense to start with a factor consistent with the second duration. The subcommittee decided to adjust for IBNR by multiplying deaths in the period 2004–2008 by 1.002, 1.004, 1.008, 1.012, and 1.02, respectively; deaths for years 1999 to 2003 were taken as complete.

2.1.5 Industry Weightings

Mortality experience varies significantly by industry. However, the data submitted to the RPP Study is not distributed by industry in the same proportions found in the full population of Canadian pension plans. For example, education is over-represented while construction and finance are under-represented in the data. The subcommittee decided to adjust the data by industry so that it would be more representative of Canadian pension plans membership.

The subcommittee referred to Statistics Canada CANSIM series 280-0011 for a count of members in Canadian defined benefit pension plans by industry. The industry groups are based on the North American Industry Classification System (NAICS), but the industry classifications in the RPP Study are based on the Standard Industrial Classification (SIC). The subcommittee split the NAICS grouping of "Educational services, health care and social assistance" into "Education" and "Other" by using the counts of employees from CANSIM series 280-0063. The weighting for policy, fire and military, was set equal to that for public administration and government since that category could not be separately identified in the CANSIM data.

The subcommittee determined the proportion by industry for the membership in Canadian DB plans, and the proportion by industry and by count in the RPP Study data. The RPP Study data by industry was then multiplied by the ratio of the StatsCan proportion to RPP Study proportion. However, there were three alterations in the weights applied to the RPP Study data—a maximum weight of 3.0, a minimum weight of 0.2, and a weight of 1.0 for industry "unknown". The ratio for some industries in the RPP Study data indicates a larger weight might be warranted. However, statistical fluctuations in smaller subsets of data might be magnified. Therefore, the weight was not allowed to exceed 3.0. Magnifying fluctuations may be a bigger issue for males than for females in the data because the difference in annuity values at age 65 with and without applying the maximum weight is -0.6% for males and 0.1% for females.

While the foregoing methodology is necessarily approximate and more precision would be preferable, the subcommittee believes that the result improves the validity of the study.

Table 6 shows the proportions by industry before adjustment, the proportion in the StatsCan data, and the weights used. The weights are applied to all the data for the industry. Thus if the weight is 2.0, the adjusted data will have double the count and income, and double the exposure and deaths for that industry. Private sector industries include those with SIC codes less than 8000 and

public sector industries are those with codes of 8000 and higher. The columns marked "Inc. Exposed" indicate the proportion of exposure, measured by income, for each industry that is used in mortality table construction.

Table 6. Proportions for industries

	RPP count		StatsCan		Weights		Inc. Exposed	
Industry	M	F	M	F	M	F	M	F
0100 - Agriculture, Mining	1.3%	0.4%	1.3%	0.2%	1.0113	0.4498	0.4%	0.1%
1500 - Construction	1.9%	0.1%	16.4%	0.4%	3.0000	3.0000	9.9%	0.1%
2000-3000 - Manufacturing	8.6%	2.8%	11.6%	2.8%	1.3560	0.9996	6.3%	0.8%
4000 - Trans, Comm or Pub Util	16.3%	1.7%	8.8%	3.3%	0.5376	1.8903	9.3%	2.1%
5000 - Wholesale or Retail	1.6%	0.9%	5.5%	4.4%	3.0000	3.0000	2.0%	0.8%
6000 - Finance, Insurance, Info	1.0%	0.8%	6.0%	9.0%	3.0000	3.0000	1.4%	1.0%
8000 - Services incl Med&Social	2.6%	14.6%	7.5%	18.0%	2.9133	1.2323	12.7%	31.1%
8200 - Educational Institutions	28.7%	42.6%	4.0%	11.6%	0.2000	0.2730	11.7%	24.1%
9000 - Public Admin or Govt	29.7%	32.9%	35.4%	49.5%	1.1918	1.5016	37.9%	38.9%
9220 - Police, Fire or Military	2.4%	0.0%	2.9%	0.0%	1.1918	1.5016	6.0%	0.1%
Unknown	5.9%	3.0%	0.8%	0.8%	1.0000	1.0000	2.3%	0.9%

2.1.6 Data Summaries—After Industry Weighting

Tables 7 and 8 show the data included in the RPP Study by gender after adjustment for industry weighting. By comparing to tables 4 and 5, it can be seen that the weightings have increased A/E ratios at all ages except for females in the 90's, but especially for males under age 70 and females under age 60. However, the weighted average year of experience has changed only slightly from 2004.39 to 2004.64.

Table 7. Experience by quin. age groups for Male pensioners, industry weighted

Male	Exposed		Deaths		A/E on UP94@2004	
Ages	Count	Pension	Count	Pension	Count	Pension
< 55	32,121	939,138,589	315	5,947,081	345.5%	213.7%
55-59	172,166	5,283,754,053	1,160	28,125,346	125.8%	99.6%
60-64	290,815	7,495,218,052	2,894	60,874,903	103.1%	85.5%
65-69	373,476	5,944,005,993	5,773	79,313,860	91.1%	79.4%
70-74	370,475	4,942,913,309	9,577	111,895,081	97.6%	85.9%
75-79	331,097	3,860,261,388	14,685	152,935,071	103.1%	92.6%
80-84	232,533	2,404,928,823	17,068	160,987,490	100.1%	91.8%
85-89	114,266	1,010,336,744	13,887	115,043,470	106.2%	100.2%
90-94	35,501	269,239,094	6,873	49,576,616	107.1%	102.3%
95-99	5,674	37,615,176	1,630	10,389,173	106.9%	103.0%
> 99	577	3,394,791	174	1,095,700	81.9%	89.2%
All ages	1,958,701	32,190,806,009	74,036	776,183,791	102.1%	91.6%

Table 8. Experience by quin. age groups for Female pensioners, industry weighted						
Female	Exposed		Deaths		A/E on UP94@2004	
Ages	Count	Pension	Count	Pension	Count	Pension
< 55	31,957	682,476,239	333	6,013,110	664.0%	540.8%
55-59	200,007	4,145,252,702	754	14,829,844	118.0%	112.4%
60-64	331,243	5,862,069,752	1,577	25,226,472	78.1%	71.8%
65-69	349,286	3,708,272,637	2,808	30,540,120	74.0%	76.3%
70-74	273,930	2,468,526,649	3,946	33,539,038	85.8%	81.4%
75-79	215,717	1,706,458,398	5,490	40,338,118	89.8%	83.9%
80-84	158,657	1,136,314,214	7,464	50,465,446	96.2%	91.0%
85-89	89,273	620,555,006	7,519	49,709,548	99.7%	94.9%
90-94	34,337	241,583,111	5,167	34,541,792	105.4%	100.0%
95-99	7,803	55,438,439	1,811	12,259,406	105.3%	100.4%
> 99	946	6,084,583	322	2,184,700	104.6%	111.8%
All ages	1,693,157	20,633,031,732	37,191	299,647,593	94.3%	89.4%

2.1.7 Public and Private Sector Data

The subcommittee split records into public sector or private sector as indicated in the data, noting the significant difference in mortality experience between the sectors. The public sector and private sector tables were prepared using the industry-weighted data. A link to the workbook containing the public and private sector experience data is provided in appendix 2.

2.1.8 Average Monthly Pensions

Table 9 shows the average monthly pension for each industry, for each sector and for both sectors combined. The first two columns are the average size as indicated in the data submitted. The last two columns adjust each year's amounts by AWE to 2014. Note that the average size for public sector is substantially higher than for private sector, and the average for males is higher than for females, especially in the private sector.

Table 9. Average monthly pension				
	As submitted		Adjusted to 2014 by AWE	
	Male	Female	Male	Female
0100 - Agriculture, Mining	481	291	620	372
1500 - Construction	1,003	300	1,276	388
2000-3000 - Manufacturing	788	302	976	384
4000 - Trans, Comm or Pub Util	1,590	720	2,084	940
5000 - Wholesale or Retail	591	298	773	389
6000 - Finance, Insurance, Info	682	475	886	609
Unknown	557	301	717	384
All private	918	412	1,178	533
8000 - Services incl Med&Social	1,354	1,068	1,761	1,384
8200 - Educational Institutions	3,052	2,278	3,975	2,950
9000 - Public Admin or Govt	1,598	864	2,032	1,095
9220 - Police, Fire or Military	3,140	2,261	3,862	2,776
All public	1,779	1,119	2,275	1,436
Composite	1,370	1,016	1,753	1,304

2.2 Table Construction Methodology—RPP Study

Bob Howard calculated the mortality tables presented in this report using a method that he developed in consultation with the subcommittee. The description of the methods, the justification for the choices of parameters, and the tables are provided in his report to the subcommittee, which is available online here.

In summary, the male and female rates in the 2014 Mortality Table, determined on an age-nearest basis, were constructed as follows:

- Mortality rates, weighted by amount of pension, experienced over ages 55 to 100 were determined based on the data provided by contributors, subject to the adjustments outlined in section 2.1.
- Reported deaths were adjusted to 2014 using the CPM Mortality Improvement Scale B.
- The experience demonstrated variations in mortality not only by gender, but also by pension income level. Mortality rates improve with high pension incomes. However, the distribution of exposure across pension income bands was not consistent across ages.
- Death amounts were therefore adjusted using the experience mortality rates on a standard distribution by amounts so that the actual varying distributions by size band for each age will have no effect on the resulting table.
- The modified data at each age were added across all sectors and size bands then graduated using the Whittaker-Henderson method.
- Mortality rates at ages below 54 were based on the ultimate, non-smoker individual Canadian life insurance mortality rates from the recently-published CIA 97–04 table, with rates from ages 54–60 obtained by fitting a 5^{th} order polynomial to the rates already obtained for ages 51, 52, 53, 61, 62, and 63.
- Mortality rates at ages over 102 were obtained from the paper delivered by Bob Howard at the 2011 Living to 100 Symposium. Similarly to the foregoing, male rates from age 95 (98 for females) to age 102 were obtained by fitting a 4^{th} order polynomial to ages 92, 93, 94, 103, and 104 (95, 96, 97, 103, and 104 for females).

2.3 Size Adjustment Factors—RPP Study

2.3.1 Why They are Included

It is evident from both the C/QPP Study and the RPP Study that mortality rates vary significantly with size of pension (other factors being equal). Size adjustment factors were derived that reflect the difference in the RPP Study experience by income band, for males and females separately.

Many objections may be raised to size adjustment factors. It would be preferable to use socio-economic class; size of pension is at best a proxy. The size of pension for an individual may reflect frequent changes in employment rather than a lower socio-economic class. There could be double counting from industries with higher mortality also having smaller pensions. It is not clear how to reflect indexing and bridge benefits. Nonetheless the correlation between mortality and pension size is very strong, strong enough that the objections mentioned above do not likely predominate. The subcommittee believes that it was most responsible to include the size adjustment factors so that actuaries could use them if they believe doing so is warranted.

2.3.2 When They May be Used

It is always preferable to use recent, credible experience from the pension plan being reviewed to adjust a standard table. However, if the pension plan does not have useful experience (e.g., the plan is too small) and there is no suitable reference by industry or a similar plan, it may be appropriate to adjust the table using size adjustment factors, particularly when the average size of pensions in the plan being valued differs significantly from that underlying the standard table.

Using size adjustment factors is always a matter of professional judgment.

When considering the possible application of the size adjustment factors, actuaries should be aware that:

- Pension amounts on which the mortality tables and size adjustment factors are based include bridge benefits and indexed pensions where applicable; and
- There is no indicator in the data as to whether included plans are closed to future accruals.

2.3.3 How to Use Size Adjustment Factors

All calculations in this report employing size adjustment factors use the factors as stated to age 85, grading linearly to 1.0 for ages 100 and higher. The subcommittee believes that it is generally a satisfactory approximation to use the factors for all ages rather than using the more complicated grading at high ages.

The most precise method of using size adjustment factors would be to group pensioner data by pension size band at the valuation date and use a separate mortality table for each band. However, it will normally be a satisfactory approximation to determine a single size adjustment factor for each gender using the average size adjustment factor weighted by pension amount. Table 10 illustrates the calculations using the size adjustment factors as proposed. The example is based on fictional data. For simplicity, all pensioners are assumed to be males age 70. The discount rate is 4%, and the calculations are performed as at January 1, 2014.

Table 10. Example of calculating pension values with size adjustments

Band	Monthly Pension Range	Number of Members	Total Monthly Pension	Monthly Average Pension	Size Adjust. Factor	Annuity Factor	Value
3	1000-1499	100	110,000	1100	1.1920	11.615	15,332,038
4	1500-1999	70	115,500	1650	1.1400	11.766	16,307,314
5	2000-2499	40	88,000	2200	1.0860	11.929	12,596,720
8	3500-3999	25	93,750	3750	0.9320	12.436	13,990,252
	Total	235	407,250	1733			58,226,324
	Weighted	235	407,250	1733	1.0945	11.903	58,168,033
	Look up	235	407,250	1733	1.1400	11.766	57,499,164

The example assumes that pension records are first summarized into size bands with increments of $500 per month. The sixth column shows values from the size adjustment table. The annuity factor in the seventh column is the present value of a monthly annuity-due of $1 per annum for a

male age 70 using CPM2014 mortality rates multiplied by the applicable adjustment factor. The last column is the product of 12, the monthly pension, and the annuity factor.

The subcommittee believes that an acceptable alternative is suggested by the row marked "Weighted". The size adjustment factor is the weighted average of the four size adjustment factors shown in the first part of the table. That is, the fourth and sixth columns are multiplied together and the sum is divided by the sum of the fourth column. The resulting value of the pensions is close to that of the exact calculation. Further testing on more realistic datasets found the "weighted" method did not deviate from the "exact" by more than 0.15%. There may be some downward bias because in all tests "weighted" was lower, but not significantly so. The subcommittee considers the "weighted" method to be a satisfactory approximation.

The last row of table 10, marked "Look up", shows a method that, although intuitive, will rarely be satisfactory. In this case the average pension, which is $1,733, is noted to fall in the size adjustment factor band 4. Therefore, the table is adjusted using the band 4 size adjustment factor. (Note that the annuity factor is the same as on the second row of the first part of the table, 11.764.) The "look up" method is not recommended.

2.4 Segments of Data—RPP Study

The main 2014 Mortality Table (CPM2014) is based on the combined RPP Study data and uses 2014 as a base year. Rates are provided for males and females for ages 18 to 115.

2.4.1 Public and Private Sector Tables

The subcommittee also produced separate tables (CPM2014Publ and CPM2014Priv) based on the public sector data and the private sector data (after the adjustments described in section 2.1). The male rates were developed directly from the RPP Study data with adjustments for low and high ages.

There were insufficient data for private sector females to support the direct construction of a table. Therefore, sector-specific female tables were developed by multiplying the 2014 Mortality Table by appropriate factor for both public sector and private sector females.

A separate set of size adjustment factors, calculated similarly to those for the composite table, are provided for each of the sector-distinct tables.

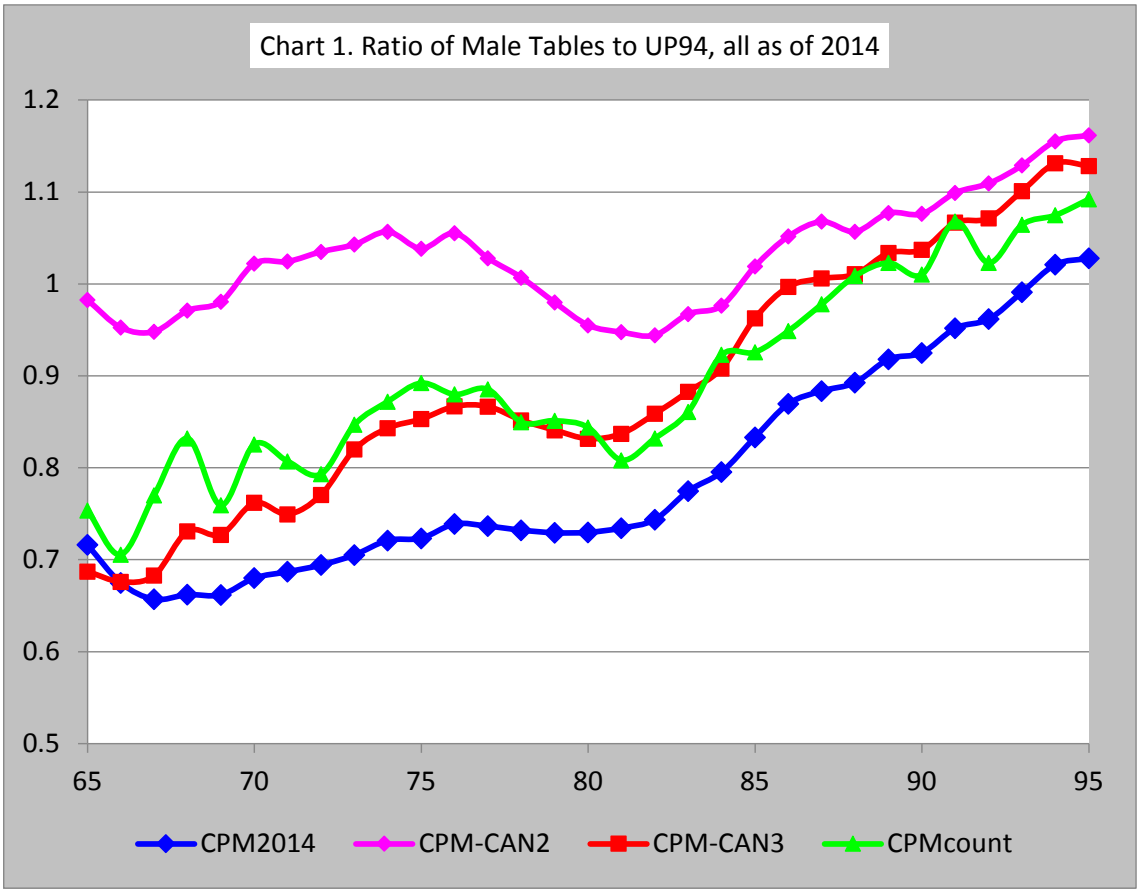
2.4.2 Industry Experience Information

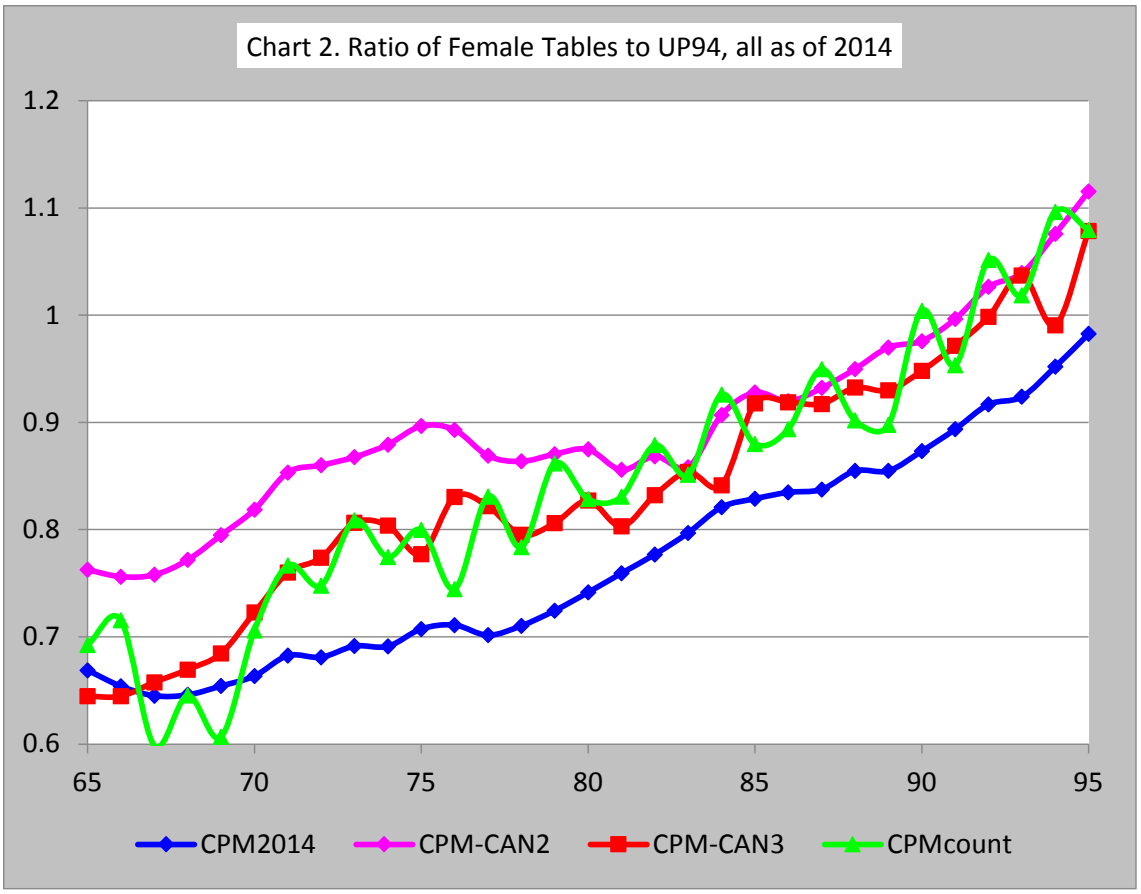
The experience observed by industry in the RPP Study dataset may be useful to pension actuaries. This information is summarized in appendix 2. In addition, the subcommittee is distributing an Excel workbook which contains tables of experience by quinquennial age groups for the composite, for the public and private sectors, and for each of the 11 industry groups included in RPP Study (a link is provided in appendix 2). Please note, however, that the experience is not equally credible in all cases, and experience for some age groups is much less credible than for some others. Accordingly, the tables contain standard deviations in A/E ratios to suggest the degree of caution needed in using the experience.

2.5 Comparison to UP94/Scale AA—RPP and C/QPP Studies

Charts 1 and 2, for males and females respectively, show the ratio of mortality rates under various tables as at 2014 relative to UP94 projected to 2014 with Scale AA (UP94@2014). The tables included are:

1. CPM2014, the 2014 Mortality Table for combined public sector and private sector data.
2. CPM-CAN2, a table from Louis Adam's C/QPP Phase II Report, based on the combined CPP and QPP experience by number of deaths and pensioners exposed for those having pensions in the range of 35–94% of the maximum values. This table is projected to 2014 on the CPM Improvement Scale B.
3. CPM-CAN3, as above but for pensions in the range of 95–100% of the maximum.
4. CPMcount, a table constructed similarly to CPM2014 but based on experience by number of pensioners rather than on the amount of pensions. [Note: this table was developed for illustrative purposes only and is not recommended for use.]





Charts 1 and 2 indicate that the tables developed using RPP Study data, measured by amounts, are significantly lower than UP94@2014 and lower than the tables developed under the C/QPP Study.

It is noteworthy that the RPP table by count is quite similar to the Class 3 table developed under the C/QPP Study. Recall the latter was developed using data for pensioners for whom pension amounts were above 94% of the C/QPP maximum pensions. This observation reinforces the importance of developing mortality tables based on pension amounts. The use of the RPP Study results, by amount, is necessary to capture the effect of the range of income for RPP pensioners beyond maximum C/QPP benefit levels.

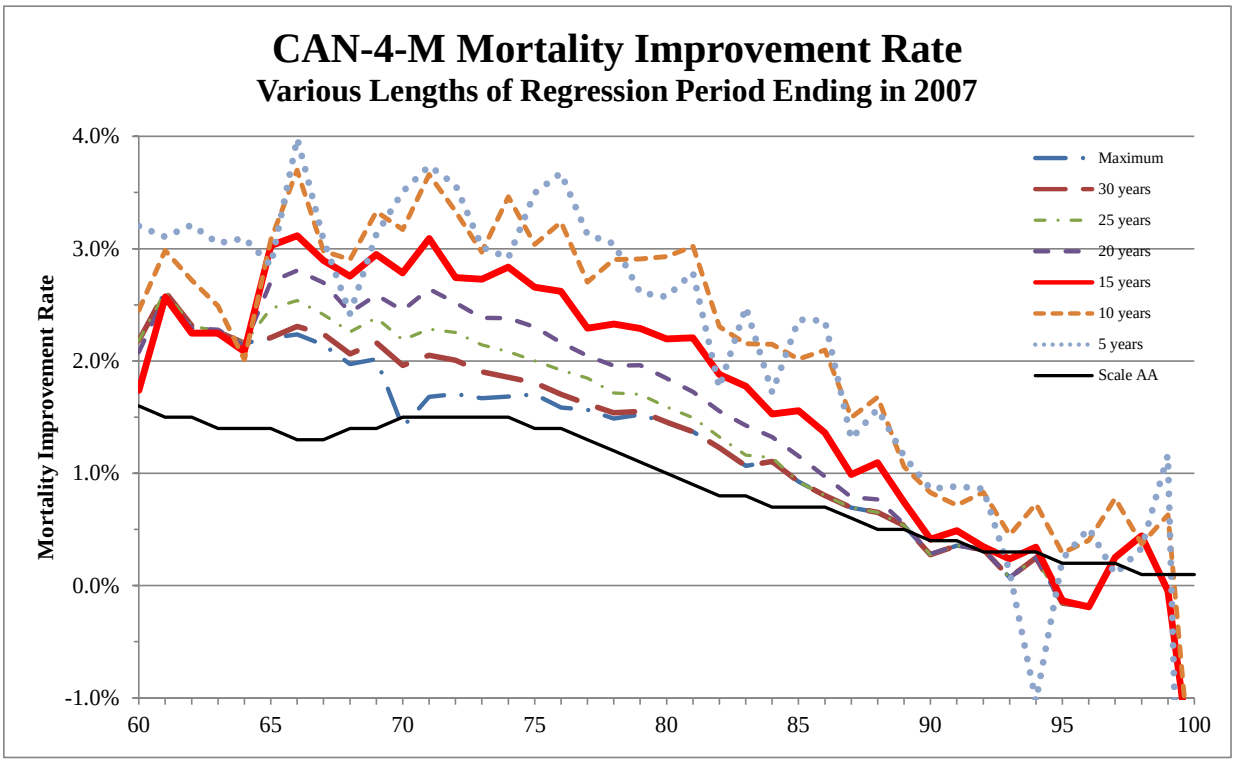
3 DEVELOPMENT OF MORTALITY IMPROVEMENT SCALES

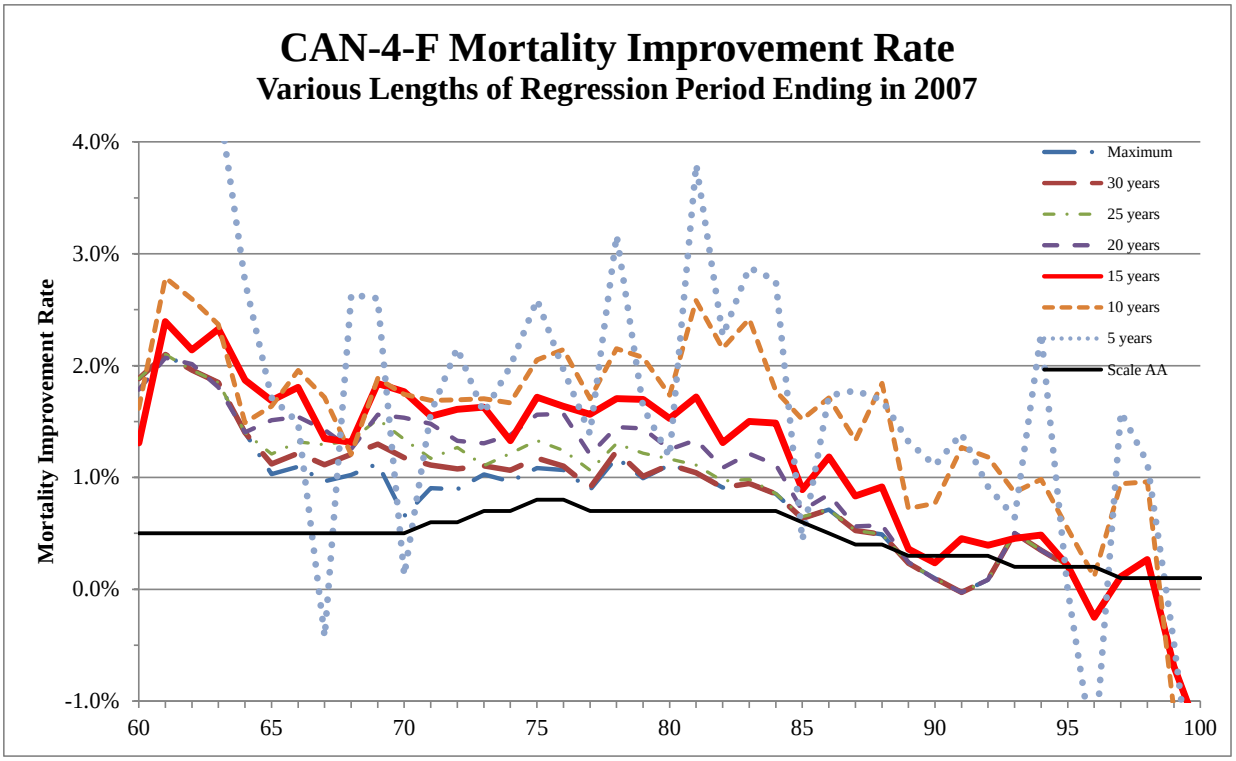
3.1 Introduction

Assumptions in respect of future mortality improvement rates are subject to a high level of uncertainty. In addition, mortality improvement rates are affected by various socio-economic factors—e.g., income, level of education, and place of residence—and extensive data and analyses are required in order to develop scales that would reflect at least some of these factors. The RPP Study has insufficient experience, over too limited a time frame, for use in the development of mortality improvement scales. On the other hand the C/QPP Study provides substantive data on recent rates of improvement in the mortality of C/QPP pensioners. The subcommittee believes that the mortality improvement scales based on the results of the C/QPP

Phase III Report with some refinements will serve as a reasonable assumption of future mortality improvement rates of Canadian pensioners in registered pension plans.

The following charts, taken from the C/QPP Phase III Report, show experienced C/QPP mortality improvement rates for various periods ending in 2007 with Scale AA improvement rates added for reference. The data reflected in these charts are based on combined CPP and QPP data for pensions in the range of 35–100% of the maximum values. Scale AA, published by the Society of Actuaries with the UP94, is currently widely used for registered pension plan valuation purposes and is prescribed for use in the pension commuted value standards.





It can be seen that the C/QPP experienced improvement rates are substantially higher than Scale AA and higher for shorter, and thus more recent, periods than over longer periods.

Social security actuaries in various countries, including Canada, have developed ultimate improvement rate assumptions well below recently-experienced rates. There is no reliable methodology to forecast the ultimate level of mortality improvement rates or the time frame as to when such ultimate rates will be reached. The C/QPP Phase III Report used as its ultimate assumptions a blend of the ultimate assumption adopted by the CPP and QPP actuaries in their December 31, 2009, valuation reports. The subcommittee agreed with this approach and used that as the ultimate in the July 31, 2013, Draft Report.

However, the CPP and QPP have recently tabled their December 31, 2012, actuarial valuations. The 26th CPP Actuarial Report mortality improvement assumptions are similar to those in the 2009 actuarial valuation with some minor increases in ultimate mortality improvement rates at certain ages. The QPP has adopted a different method for mortality improvement assumptions compared to the prior valuation and compared to the CPP methodology. Since the QPP method produces life expectancies not significantly different from those produced by the CPP method, the ultimate mortality improvement rates used in the development of the CPM-B scale were determined by reference to the CPP assumptions only. A comparison of life expectancies developed in accordance with the CPP and QPP assumptions is provided here.

Furthermore, the CPM-B scale extends non-zero improvement rates to very high ages, consistent with the assumption made in the 26th CPP Actuarial Report.

3.2 Improvement Scales

The gender-specific improvement scales were constructed as follows:

- Short-term rates applicable to years 2000–2011 are set equal to the smoothed 10-year experience based on the C/QPP income class 4 (35% of maximum pension and above) from the C/QPP Study for ages 65 and higher.
- Short-term rates for years 2000–2011 for ages up to age 50 are set equal to the CPP assumption for 2010 as reported in the 26th CPP Actuarial Report. Note that mortality experience data are not available for C/QPP at these younger ages.
- Short-term rates for years 2000–2011 for ages 51–64 are a linear interpolation between the above rates for ages 50 and 65.
- Ultimate rates, applicable for years 2030 and beyond, for ages 0–114 are set equal to the CPP year 2030 actuarial assumptions for those ages, as disclosed in the 26th CPP Actuarial Report. Rates for ages 115 and higher are zero.
- Rates for years 2012 to 2029 are derived by linear interpolation between the short-term rates and the ultimate rates.

3.3 Transitional One-Dimensional Mortality Improvement Scale

The subcommittee believes strongly that a two-dimensional improvement scale fits the experience data better than any one-dimensional scale could and can better reflect reasonable expectations regarding the evolution of the improvement in mortality rates in future years. However, the subcommittee also recognizes that not all practitioners will have immediate access to software that can handle a two-dimensional improvement scale. Therefore, as a transitional measure, the subcommittee has developed a one-dimensional improvement scale, CPM-B1D2014, which reasonably approximates the effect of CPM-B for calculation dates that are between January 1, 2014, and December 31, 2015. Note that CPM-B1D2014 is intended for use only with mortality tables CPM2014, CPM2014publ, and CPM2014priv.

The development of CPM-B1D2014 is documented in the memo to the subcommittee from Bob Howard, which can be accessed online here.

4 FINANCIAL IMPLICATIONS

4.1 Overview

The UP-94 Mortality Table, adjusted for mortality improvement Scale AA, has been widely used for pension plan valuations and is prescribed for use in the pension commuted value standards of practice. The results of the RPP and C/QPP Studies indicate that the overall level of recent mortality experience is significantly lower than that anticipated by UP-94 with Scale AA and exhibits a different shape by age. The C/QPP Study also shows that mortality improvement rates experienced in recent years have been substantially higher than indicated by Scale AA.

The experience illustrated by both the C/QPP Study and RPP Study indicates that adoption of tables and scales reflecting Canadian mortality experience is warranted.

4.2 Numerical Illustrations

The adoption of the tables presented in this report will likely result in an increase in recognized costs for Canadian pension plans and their sponsors to the extent that the mortality tables and improvement scales used in recent valuations have not reflected recent experience.

Tables 11 through 16 below compare the present value of annuities based on various tables. Tables 11 through 13 show monthly annuities-due and tables 14 through 16 show monthly annuities deferred to age 65. The calculations are done at 4% interest as at January 1, 2014. Each

table indicates what base table and improvement scale were used in the calculation. Also included below is table 17, which shows life expectancies.

Table 11 shows the impact of changing from UP-94 with Scale AA to the basis presented in this report. Note that the increase is generally larger because of changing from UP-94 to CPM2014 than changing from Scale AA to the CPM Improvement Scale B.

Table 11. Monthly life annuities at 4% in 2014 without size adjustment

Table	UP-94	CPM2014		CPM2014	
Scale	AA	AA		CPM-B	
	Annuity	Annuity	Incr	Annuity	Incr
M55	16.68	17.23	3.3%	17.36	4.1%
M65	13.06	13.98	7.0%	14.17	8.5%
M75	9.09	9.87	8.5%	10.03	10.3%
M85	5.38	5.65	5.0%	5.69	5.7%
F55	17.41	18.04	3.6%	18.23	4.7%
F65	14.10	14.94	6.0%	15.13	7.3%
F75	10.28	11.01	7.1%	11.16	8.6%
F85	6.25	6.63	6.2%	6.68	6.9%

Table 12 shows the impact of the size adjustments. (The average size of the pensions in the RPP dataset is approximately $2,400 per month when adjusted to 2014.) Clearly the size adjustments are material, but more for males than females. Of course, in practice the actuary will adjust for recent, credible experience where available rather than simply for size. The size adjustment factors may be useful when no such experience is available.

Table 12. Monthly life annuities on CPM2014 with CPM-B at 4% in 2014 with size adjustment for the indicated monthly pension

Pension	not adjusted	$1,200		$2,400		$3,600	
	Annuity	Annuity	Incr	Annuity	Incr	Annuity	Incr
M55	17.36	16.92	-2.5%	17.16	-1.2%	17.52	0.9%
M65	14.17	13.66	-3.6%	13.94	-1.7%	14.37	1.4%
M75	10.03	9.49	-5.4%	9.78	-2.5%	10.24	2.1%
M85	5.69	5.28	-7.1%	5.50	-3.3%	5.84	2.7%
F55	18.23	18.12	-0.6%	18.27	0.2%	18.38	0.8%
F65	15.13	15.00	-0.9%	15.19	0.4%	15.32	1.3%
F75	11.16	11.01	-1.3%	11.22	0.6%	11.37	1.9%
F85	6.68	6.57	-1.7%	6.73	0.7%	6.85	2.5%

Because the size adjustment factors do not have a linear relationship with size, it is not enough to consider the average size of pension within a pension plan.

Table 13 compares the sector-distinct tables with the composite table. The calculations are done assuming the same size annuity to make the comparison more appropriate than by using the

tables without adjustment. Whether to use the composite table or a sector-distinct table may be a material choice.

Table 13. Monthly life annuities at 4% in 2014 with size adjustment factor for $2400 per month

Table	CPM2014	CPM2014Publ		CPM2014Priv	
Scale	CPM-B	CPM-B		CPM-B	
	Annuity	Annuity	Incr	Annuity	Incr
M55	17.16	17.29	0.8%	17.01	-0.8%
M65	13.94	14.04	0.8%	13.78	-1.1%
M75	9.78	9.86	0.8%	9.68	-1.0%
M85	5.50	5.53	0.6%	5.51	0.2%
F55	18.27	18.28	0.0%	18.18	-0.5%
F65	15.19	15.19	0.0%	15.07	-0.8%
F75	11.22	11.23	0.1%	11.09	-1.2%
F85	6.73	6.74	0.1%	6.63	-1.5%

Tables 14 through 16 are analogous to tables 11 through 13 but for deferred annuities. The conclusions reached are essentially the same as mentioned for the tables above.

Table 14. Monthly life annuities deferred to age 65 at 4% in 2014 without size adjustment

Table	UP-94	CPM2014		CPM2014	
Scale	AA	AA		CPM-B	
	Annuity	Annuity	Incr	Annuity	Incr
M25	2.82	2.92	3.5%	2.89	2.6%
M35	4.07	4.25	4.4%	4.24	4.1%
M45	5.88	6.19	5.2%	6.23	5.9%
M55	8.57	9.13	6.6%	9.26	8.1%
F25	2.93	3.09	5.6%	3.17	8.3%
F35	4.28	4.53	5.8%	4.64	8.4%
F45	6.27	6.66	6.2%	6.80	8.5%
F55	9.25	9.86	6.6%	10.04	8.6%

Table 15. Monthly life annuities on CPM2014 with CPM-B deferred to age 65 at 4% in 2014 with size adjustment for the indicated monthly pension

Pension	not adjusted	$1,200		$2,400		$3,600	
	Annuity	Annuity	Incr	Annuity	Incr	Annuity	Incr
M25	2.89	2.76	-4.4%	2.83	-2.0%	2.94	1.7%
M35	4.24	4.05	-4.5%	4.15	-2.1%	4.31	1.7%
M45	6.23	5.95	-4.5%	6.10	-2.1%	6.34	1.7%
M55	9.26	8.86	-4.4%	9.07	-2.0%	9.41	1.6%
F25	3.17	3.14	-0.9%	3.18	0.4%	3.21	1.4%
F35	4.64	4.59	-1.0%	4.66	0.4%	4.70	1.4%
F45	6.80	6.74	-1.0%	6.83	0.4%	6.90	1.5%
F55	10.04	9.94	-1.0%	10.09	0.4%	10.19	1.4%

Table 16. Monthly life annuities deferred to age 65 at 4% in 2014 with size adjustment factor for $2400 per month

Table	CPM2014	CPM2014Publ		CPM2014Priv	
Scale	CPM-B	CPM-B		CPM-B	
	Annuity	Annuity	Incr	Annuity	Incr
M25	2.83	2.86	1.2%	2.79	-1.4%
M35	4.15	4.20	1.2%	4.09	-1.4%
M45	6.10	6.18	1.3%	6.01	-1.5%
M55	9.07	9.19	1.3%	8.94	-1.5%
F25	3.18	3.18	0.0%	3.16	-0.8%
F35	4.66	4.66	0.0%	4.62	-0.9%
F45	6.83	6.84	0.0%	6.77	-0.9%
F55	10.09	10.09	0.1%	10.00	-0.9%

Table 17 is similar to Table 11, but the calculation is complete life expectancy rather than a life annuity. The calculation is done on a generational basis using the improvement scale indicated. Life expectancies change in the same direction as life annuities, but the percentage increase is larger.

Table 17. Complete life expectancies, with generational projection, in 2014					
Table	UP-94	CPM2014		CPM2014	
Scale	AA	AA		CPM-B	
	Years	Years	Incr	Years	Incr
M55	29.18	30.85	5.8%	31.30	7.3%
M65	19.80	21.65	9.4%	22.11	11.7%
M75	12.04	13.26	10.1%	13.55	12.5%
M85	6.35	6.69	5.3%	6.74	6.1%
F55	31.45	33.36	6.1%	34.02	8.2%
F65	22.13	23.94	8.2%	24.43	10.4%
F75	14.06	15.28	8.7%	15.57	10.7%
F85	7.56	8.08	6.8%	8.15	7.7%

5 CHANGES FROM JULY 2013 DRAFT REPORT

The Draft Report for Comments, Canadian Pensioners' Mortality was published on July 31, 2013. The Draft Report elicited extensive comments from approximately 30 diverse sources. The subcommittee thanks all those who provided comments.

The subcommittee carefully reviewed all the comments and revisited most aspects of the work. As a result, the Final Report, Canadian Pensioners' Mortality incorporates a number of improvements and refinements compared to the Draft Report. The most significant changes and their rationale are discussed below. In addition, the final report includes commentary on the data and methods used to develop the final mortality tables and mortality improvement scale.

The subcommittee also received a number of comments that pertain directly to the assumptions under the pension commuted value standard. These have been forwarded to the Actuarial Standards Board.

Changes from the Draft Report address four major areas, as discussed below.

5.1 Representativeness of RPP Study Data

The subcommittee was satisfied that the RPP Study data used for the Draft Report was of good quality and sufficient volume to develop the mortality tables presented. However, available information regarding characteristics of the data (i.e., industry and collar type) was very limited, especially for the private sector.

The subcommittee took steps to obtain additional data. In particular:

- Two contributors, whose data had not been accepted for the Draft Report, provided revised data which met the acceptance criteria and are included for purposes of the final report;
- Additional industry information was obtained from one contributor whose data were already included at the Draft Report stage; and
- The data for one contributor were found in some cases to have included multiple records in respect of individual pensioners. The records pertaining to a single pensioner were combined into one.

As a result, the tables in the final report are developed using a slightly larger data set and with an allocation by industry for a high proportion of the data.

The subcommittee compared the distribution of lives exposed by industry in the revised data to the distribution of Canadian pension plan members by industry from CANSIM data. Significant differences were found between the two distributions. The most important differences were that the RPP Study data are significantly under-weighted for construction and finance, and over-weighted for education.

The final RPP Study mortality tables were developed from the study data modified to reflect weightings by industry derived from CANSIM data regarding pension plan membership.

5.2 Mortality by Industry and Collar Type

A number of comments requested that the subcommittee provide information on mortality by industry and/or by collar type rather than, or in addition to, the information provided in the Draft Report by pension size.

In preparing the final report, information regarding industry was obtained for most of the study data and mortality experience by industry, which could be referenced to adjust the composite or public/private tables when plan specific experience is not available, is included.

The subcommittee agrees that it would be desirable to also have white collar and blue collar mortality tables. However, only a very small proportion of the RPP Study retiree data had an indication that they had been employed on an hourly or salaried basis prior to retirement. For the rest of the data there is no sure way of making an allocation.

In order to distribute the RPP Study data to blue, white, and mixed collar categories, the subcommittee split records indicated as hourly or salaried accordingly. For all other records, the subcommittee split them into collar groupings on a subjective basis for each industry. The results of this analysis did not provide satisfactory results and, accordingly, no distinct tables by collar type are being provided in this report.

5.3 Size Adjustments

Many comments questioned the suitability of the size adjustment methodology and pointed out limitations in their use. The subcommittee continues to acknowledge that this information needs to be applied with discretion and judgment depending on the circumstances of a particular plan. Nevertheless, the data show strong correlation between mortality and pension size, and therefore updated size adjustment factors are included in the final report.

5.4 Mortality Improvement Scale

The CPM-A improvement scale provided in the Draft Report assumes ultimate improvement rates consistent with the assumptions previously used by the C/QPP actuaries.

A number of comments pointed to the use of significantly higher ultimate improvement rates in the UK, and to a lesser extent in the U.S., and suggested that such higher rates should be considered for Canadian pension plan purposes. Comments to the contrary were also received. In addition, it must be acknowledged that the ultimate rates used for CPM-A are substantially below recent experience and on the low side of longer-term Canadian population experience.

On the other hand, the subcommittee observes:

- Canadian mortality is already lower than UK and U.S. mortality, which may result in less scope for future improvements in the long term;
- UK assumptions referenced would, in some cases, include margins for adverse deviations, for example, as used by insurance companies; and
- No compelling scientific methodology exists for the derivation of long-term future mortality improvement rates.

Therefore, the subcommittee has retained consistency with the C/QPP ultimate improvement assumptions. More specifically, the assumptions have been updated to coincide with the assumptions used in the recently published 26th CPP Actuarial Report, and non-zero improvement rates were extended to very high ages. These assumptions are also reasonably consistent with the assumptions used in the recently published QPP valuation report.

There was considerable diversity of opinion regarding the shape of the mortality improvement scale between the recently observed rates and the assumed ultimate rates. After due consideration, the subcommittee concluded that a linear interpolation served as a sufficient middle ground.

5.5 Response to Other Comments

Following are responses to a number of other comments received on the Draft Report.

5.5.1 Cohort Effect

Some commented that the assumptions should reflect a cohort effect. The subcommittee acknowledges that a cohort effect can be observed in historical Canadian population mortality improvement rates for males and that including a cohort could be considered. However, testing has shown that, assuming the base table is appropriate, putting a cohort effect into future improvement rates, based on the Canadian population experience, does not significantly change the present value of annuities (for example, less than 0.3% for a cohort effect with a difference of 1% in the improvement rate from the peak to the surrounding rates) and for most pension valuations the impact would be negligible.

5.5.2 Exclusion of Beneficiary and Active Life Data

While beneficiary data were collected for the RPP Study, they were not included in table construction. The quality of the data was not as good as those provided for pensioners and the beneficiary data could have dominated the experience for private sector females.

The subcommittee agrees that it would be desirable to provide credible information on active lives; however, the quality of active life data in the RPP Study was very poor. Over half of the records had no salary coded and a review of the data indicated material errors in the reporting of deaths.

5.5.3 Mortality Relative to Duration since Retirement

Some asked whether duration from retirement was a material element. It is difficult to answer this question from the RPP Study dataset because the vast majority of data are at the higher durations. However, the experience points to only a small effect for duration. The subcommittee calculated sample annuity values based on select and ultimate mortality rates, adjusting mortality rates by the actual to expected ratios observed at each duration. These annuity values at 4% were generally within 0.5% of those calculated on the proposed table.

5.5.4 Insufficient Provincial Representation

It is observed that some provinces are under-represented in the RPP Study data. The subcommittee hopes to encourage more participation in future studies to improve the ability to provide meaningful mortality experience information by province and/or region.

5.5.5 Extend Mortality Rates to Ages Below 18

The objective of the RPP and C/QPP studies was to build base mortality tables and mortality improvement scales that may be used for a broad range of Canadian pension plans. As such, it is not expected that rates prior to age 18 would be relevant.

5.5.6 Possible Effect of Portability Selection

One commenter suggests that Canadian pension legislation might contribute to lower pensioner mortality at younger ages as a result of portability—more plans providing portability at retirement and the availability of a lump sum for members in ill health. It is uncertain that the plans included in the RPP Study provide such portability provisions. Future studies may reveal emerging trends that may support this contention.

5.6 Overall Impact of Changes

There were many changes to the mortality tables and improvement scales presented in this report from those provided with the Draft Report. Table 18 summarizes the net effect of all the changes between the draft and final reports.

The effect of the change is measured by changes in the present value of a monthly life annuity at 4% in 2014. Both the mortality table and improvement scale have changed. The changes in the mortality tables are much more significant than the changes in the improvement scale. As a result of changing the improvement rates only, the present value of life annuities generally increase by about 0.1% to 0.2% for males and 0.2% to 0.3% for females.

Table 18. Increases in monthly life annuity values at 4% from draft report to final

	Composite	Public	Private
M55	-1.5%	-1.0%	-0.6%
M65	-1.3%	-0.9%	0.2%
M75	-1.3%	-0.7%	0.1%
M85	-0.3%	1.2%	0.0%
F55	-0.4%	-0.4%	0.5%
F65	-0.4%	-0.3%	1.0%
F75	-0.6%	-0.6%	1.5%
F85	0.6%	0.6%	4.3%

6 FUTURE RESEARCH

The subcommittee has a continuing mandate to monitor Canadian pension plan experience and develop updated mortality tables and mortality improvement scales as deemed appropriate from time to time.

In the near term, the subcommittee plans to conduct an analysis of C/QPP mortality experience to examine, in particular, changes in experience subsequent to 2007 (the latest date of data reflected in developing the CPM-B improvement scale and the latest date of data included in the RPP Study). Subsequently, a further RPP study may be contemplated.

For any subsequent RPP study, the possibility of obtaining more data with additional information regarding collar type and other relevant details will need to be considered in the context of the effort required of contributors which affects the likelihood of obtaining a good volume of data.

It should also be noted that the Institute has commenced a group annuity mortality study, which is expected to have some relevance to the mortality experience of Canadian pensioners.

APPENDIX 1: SAMPLE RATES AND FACTORS

It will generally be more useful to obtain the rates and factors from the Excel workbooks provided at the relevant points within this report. However, rates for the main ages are shown in the following three tables.

Table A1-1. Mortality Tables, ages 60-100 displayed						
	CPM2014		CPM2014publ		CPM2014priv	
Age	Male	Female	Male	Female	Male	Female
60	0.00628	0.00350	0.00531	0.00348	0.00727	0.00385
61	0.00666	0.00384	0.00570	0.00381	0.00787	0.00422
62	0.00702	0.00421	0.00612	0.00418	0.00847	0.00463
63	0.00743	0.00464	0.00658	0.00460	0.00905	0.00510
64	0.00790	0.00511	0.00707	0.00507	0.00964	0.00561
65	0.00844	0.00562	0.00762	0.00558	0.01024	0.00618
66	0.00907	0.00617	0.00824	0.00612	0.01089	0.00678
67	0.00981	0.00675	0.00893	0.00671	0.01163	0.00742
68	0.01066	0.00739	0.00973	0.00734	0.01253	0.00812
69	0.01166	0.00809	0.01064	0.00803	0.01361	0.00889
70	0.01282	0.00886	0.01169	0.00880	0.01488	0.00974
71	0.01417	0.00973	0.01290	0.00966	0.01636	0.01069
72	0.01571	0.01072	0.01431	0.01064	0.01808	0.01178
73	0.01749	0.01185	0.01593	0.01177	0.02007	0.01303
74	0.01952	0.01316	0.01781	0.01307	0.02236	0.01447
75	0.02183	0.01469	0.01999	0.01459	0.02500	0.01615
76	0.02449	0.01649	0.02251	0.01638	0.02801	0.01812
77	0.02754	0.01859	0.02544	0.01847	0.03146	0.02044
78	0.03105	0.02106	0.02884	0.02091	0.03541	0.02315
79	0.03511	0.02394	0.03279	0.02377	0.03993	0.02631
80	0.03981	0.02729	0.03735	0.02711	0.04507	0.03000
81	0.04522	0.03118	0.04261	0.03097	0.05092	0.03428
82	0.05144	0.03568	0.04864	0.03544	0.05753	0.03922
83	0.05854	0.04085	0.05552	0.04057	0.06496	0.04490
84	0.06660	0.04677	0.06333	0.04645	0.07327	0.05141
85	0.07571	0.05352	0.07217	0.05316	0.08252	0.05883
86	0.08596	0.06118	0.08213	0.06079	0.09277	0.06685
87	0.09744	0.06984	0.09331	0.06943	0.10412	0.07585
88	0.11026	0.07959	0.10583	0.07916	0.11667	0.08591
89	0.12454	0.09054	0.11981	0.09009	0.13054	0.09713
90	0.14041	0.10280	0.13540	0.10233	0.14587	0.10960
91	0.15801	0.11650	0.15277	0.11602	0.16282	0.12343
92	0.17750	0.13178	0.17209	0.13131	0.18159	0.13876
93	0.19909	0.14883	0.19358	0.14836	0.20238	0.15572
94	0.22299	0.16783	0.21749	0.16738	0.22543	0.17450
95	0.24808	0.18902	0.24273	0.18859	0.24970	0.19527
96	0.27346	0.21263	0.26845	0.21225	0.27436	0.21826
97	0.29848	0.23897	0.29400	0.23865	0.29882	0.24371
98	0.32273	0.26615	0.31895	0.26591	0.32267	0.26967
99	0.34602	0.29275	0.34308	0.29261	0.34575	0.29468
100	0.36843	0.31779	0.36639	0.31779	0.36811	0.31779

Table A1-2. Size Adjustment Factors

Monthly Income	CPM2014		CPM2014publ		CPM2014priv	
	Male	Female	Male	Female	Male	Female
0-499	1.285	1.141	1.370	1.146	1.141	1.089
500-999	1.240	1.098	1.314	1.103	1.113	1.048
1000-1499	1.192	1.055	1.255	1.060	1.081	1.007
1500-1999	1.140	1.013	1.193	1.018	1.047	0.967
2000-2499	1.086	0.977	1.128	0.981	1.010	0.932
2500-2999	1.031	0.947	1.065	0.951	0.976	0.903
3000-3499	0.978	0.930	1.005	0.934	0.945	0.887
3500-3999	0.932	0.923	0.956	0.927	0.921	0.881
4000-4499	0.893	0.922	0.913	0.926	0.906	0.880
4500-4999	0.856	0.922	0.874	0.926	0.891	0.880
5000-5499	0.818	0.922	0.834	0.926	0.875	0.880
5500-5999	0.779	0.922	0.792	0.926	0.854	0.880
More	0.739	0.922	0.750	0.926	0.827	0.880

Table A1-3. CPM-B for years 2011 and 2030. Intervening years are by linear interpolation. CPM-B1D2014 is also shown. Ages 60-100 shown.

	CPM-B 2011		CPM-B 2030		CPM-B1D2014	
Age	Male	Female	Male	Female	Male	Female
60	0.02633	0.01630	0.00800	0.00800	0.00550	0.00490
61	0.02747	0.01678	0.00800	0.00800	0.00590	0.00520
62	0.02860	0.01726	0.00800	0.00800	0.00630	0.00560
63	0.02973	0.01774	0.00800	0.00800	0.00680	0.00600
64	0.03087	0.01822	0.00800	0.00800	0.00740	0.00650
65	0.03200	0.01870	0.00800	0.00800	0.00810	0.00690
66	0.03200	0.01870	0.00800	0.00800	0.00810	0.00700
67	0.03200	0.01870	0.00800	0.00800	0.00830	0.00700
68	0.03200	0.01870	0.00800	0.00800	0.00870	0.00700
69	0.03200	0.01870	0.00800	0.00800	0.00920	0.00700
70	0.03200	0.01870	0.00800	0.00800	0.00990	0.00690
71	0.03180	0.01870	0.00800	0.00800	0.01060	0.00700
72	0.03160	0.01870	0.00800	0.00800	0.01140	0.00710
73	0.03140	0.01870	0.00800	0.00800	0.01230	0.00740
74	0.03120	0.01870	0.00800	0.00800	0.01320	0.00770
75	0.03100	0.01870	0.00800	0.00800	0.01420	0.00820
76	0.03080	0.01870	0.00800	0.00800	0.01530	0.00880
77	0.03060	0.01870	0.00800	0.00800	0.01630	0.00940
78	0.03040	0.01870	0.00800	0.00800	0.01740	0.01010
79	0.03020	0.01870	0.00800	0.00800	0.01850	0.01080
80	0.03000	0.01870	0.00800	0.00800	0.01950	0.01160
81	0.02800	0.01870	0.00800	0.00800	0.01900	0.01220
82	0.02600	0.01870	0.00800	0.00800	0.01830	0.01290
83	0.02400	0.01870	0.00760	0.00760	0.01750	0.01340
84	0.02200	0.01870	0.00720	0.00720	0.01650	0.01390
85	0.02000	0.01870	0.00680	0.00680	0.01540	0.01450
86	0.01800	0.01696	0.00640	0.00640	0.01430	0.01350
87	0.01600	0.01522	0.00600	0.00600	0.01300	0.01250
88	0.01400	0.01348	0.00560	0.00560	0.01170	0.01140
89	0.01200	0.01174	0.00520	0.00520	0.01040	0.01030
90	0.01000	0.01000	0.00480	0.00480	0.00890	0.00910
91	0.00800	0.00800	0.00440	0.00440	0.00750	0.00760
92	0.00600	0.00600	0.00400	0.00400	0.00590	0.00610
93	0.00400	0.00400	0.00380	0.00380	0.00440	0.00450
94	0.00200	0.00200	0.00360	0.00360	0.00280	0.00290
95	0.00000	0.00000	0.00340	0.00340	0.00110	0.00120
96	0.00000	0.00000	0.00320	0.00320	0.00100	0.00110
97	0.00000	0.00000	0.00300	0.00300	0.00090	0.00100
98	0.00000	0.00000	0.00300	0.00300	0.00090	0.00100
99	0.00000	0.00000	0.00300	0.00300	0.00090	0.00090
100	0.00000	0.00000	0.00300	0.00300	0.00090	0.00090

APPENDIX 2: EXPERIENCE BY INDUSTRY

As part of the RPP Study, the subcommittee reviewed the mortality experience by industry. Generally, there are insufficient data to develop mortality tables by industry. However, the subcommittee's observations may be useful to actuaries where specific plan experience or similar plan experience is not available. The subcommittee has prepared a workbook which contains A/E ratios by quinquennial age groups for each sector and industry. Note that the A/E ratios are not equally credible for all industries, nor by age groups within industry. Accordingly the subcommittee urges caution in the use of the information.

The following tables summarize the information in the workbook. See the workbook for more information and a more detailed explanation, available here.

The columns marked "Adjusted" use size adjustments to determine expected deaths, but the columns marked "Base" do not. If an actuary has data with average size very similar to that in the subcommittee's data, then it may be sufficient to use "Base", but the greater the difference in average size, the more important it will be to use size adjustments on the actuary's data and refer to the ratios in the "Adjusted" column.

Table A2-1. Experience for Public data - Male

	Exposure		Deaths		A/E on CPM2014publ		
	Count	Amount	Count	Amount	Base	Adjusted	Std Dev
8000 - Services incl Med&Social	86,457	1,405,153,387	2,846	30,445,048	117.0%	106.0%	3.1%
8200 - Educational Institutions	516,133	18,903,056,676	10,066	279,431,038	86.6%	94.9%	1.1%
9000 - Public Admin or Govt	533,617	10,230,626,525	15,969	219,443,681	101.4%	94.5%	1.1%
9220 - Police, Fire or Military	43,180	1,627,026,767	702	21,634,141	113.9%	119.0%	4.4%
All, weighted	1,026,406	21,915,357,483	29,271	427,732,629	102.5%	97.9%	0.8%

Table A2-2. Experience for Public data - Female

	Exposure		Deaths		A/E on CPM2014publ		
	Count	Amount	Count	Amount	Base	Adjusted	Std Dev
8000 - Services incl Med&Social	406,590	5,210,278,324	8,664	74,274,227	120.4%	116.0%	1.5%
8200 - Educational Institutions	667,267	18,240,930,761	11,982	230,440,397	94.2%	97.3%	1.1%
9000 - Public Admin or Govt	516,311	5,350,705,547	8,796	69,687,260	99.6%	95.6%	1.4%
9220 - Police, Fire or Military	509	13,823,016	8	216,749	381.4%	391.0%	71.8%
All, weighted	1,446,019	19,410,830,605	26,577	257,661,572	104.6%	102.5%	0.9%

Table A2-3. Experience for Private data - Male							
	Exposure		Deaths		A/E on CPM2014priv		
	Count	Amount	Count	Amount	Base	Adjusted	Std Dev
100 - Agriculture, Mining	22,688	130,821,259	1,178	6,092,748	92.2%	86.8%	4.4%
500 - Construction	88,126	1,060,598,466	3,133	26,286,818	112.5%	108.3%	2.7%
2000-3000 - Manufacturing	157,410	1,489,211,521	7,917	47,921,208	101.5%	97.3%	1.9%
4000 - Trans, Comm or Pub Util	293,437	5,597,359,994	14,371	199,127,855	106.5%	106.0%	1.1%
5000 - Wholesale or Retail	30,413	215,528,430	1,737	10,793,006	98.5%	93.9%	3.7%
6000 - Finance, Insurance, Info	18,457	150,961,855	1,109	7,590,401	92.0%	91.1%	5.3%
Unknown	111,006	741,905,439	6,272	32,066,830	88.1%	85.5%	2.3%
All, weighted	932,294	10,275,448,527	44,764	348,451,162	102.6%	99.8%	0.7%

Table A2-4. Experience for Private data - Female							
	Exposure		Deaths		A/E on CPM2014priv		
	Count	Amount	Count	Amount	Base	Adjusted	Std Dev
100 - Agriculture, Mining	6,700	23,392,803	338	976,806	102.9%	99.3%	8.8%
500 - Construction	1,928	6,929,749	80	229,991	117.5%	113.3%	19.5%
2000-3000 - Manufacturing	44,652	161,750,661	2,178	5,816,087	114.0%	109.8%	3.8%
4000 - Trans, Comm or Pub Util	27,153	234,624,831	1,009	6,546,675	106.7%	106.7%	4.3%
5000 - Wholesale or Retail	14,844	53,057,370	561	2,067,326	106.2%	103.7%	7.3%
6000 - Finance, Insurance, Info	12,003	68,414,377	578	2,834,810	92.3%	92.5%	7.1%
Unknown	48,573	175,704,648	2,127	6,208,471	96.2%	94.6%	4.3%
All, weighted	247,139	1,222,201,127	10,613	41,986,021	102.4%	101.2%	1.7%