

Study

Canadian Group Annuitant Mortality Experience, Calendar Years 2007–2012

Pension and Group Annuity Experience
Subcommittee –
Research Committee

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1 Executive Summary

This is the inaugural report of a study of experience under the group annuities of life insurance companies. There are six years of data included, and the amount of experience is a little less than that of the individual annuitant experience study and exceeds that which underlies the construction of CPM2014priv (but not CPM2014, the combined public and private table).

The experience is broadly consistent with that of CPM2014priv, but there are variations by age which may be material.

The variation in experience by size is similar to that observed in the CPM study. There is some suggestion that the slope by size could be steeper for males in this study than in CPM, but there is not enough data to be confident.

2 Table of Contents

1	Executive Summary	2
2	Table of Contents.....	2
3	Introduction.....	2
4	Overview.....	3
5	Analyses.....	9
5.1	Single/Joint.....	9
5.2	Defined Benefit or not.....	9
5.3	Size of income	10
5.4	Duration from retirement	13
6	Supplementary Information	13
7	Subcommittee	14
8	References	14

3 Introduction

The CIA has, since the 1980s, collected data on individual annuitant mortality. In 2014, it published a mortality table based on data collected from a number of pension plans. There is another significant group of annuitants that is worthy of study, and that is the group annuitant experience of life insurance companies in Canada. Accordingly, the CIA Research Committee (ResCo) initiated a study in 2013. There has now been sufficient data collected to warrant publishing a report.

Six life insurance companies are currently participating in the intercompany study. Table 1 shows the companies and the proportion of exposure, measured by income, contributed by each.

Table 1. Proportion of exposure by income from contributing companies.	
Company	Share
Canada Life	18%
Desjardins	7%
Industrial-Alliance	16%
Manulife	13%
Standard Life	21%
Sun Life	24%

Throughout this report, expected mortality is calculated on CPM2014priv with projection on CPM-B to the appropriate calendar year, without size adjustments unless expressly stated. (This mortality basis is called “qCPM” in this report for convenience.) CPM2014priv is used rather than the composite CPM2014 because it is unlikely that group annuitant business includes many annuities from the public sector. The use of qCPM should not be inferred as an indication of it being appropriate for this block of business. There is not yet any published table that is directly relevant. This study will observe how closely qCPM fits to group annuitant mortality experience.

Several tables in this report show standard deviations in the actual-to-expected ratios. These ratios are calculated on the assumption that the exposure of each life to death in the next year is independent of the exposure for all other lives, that the number of deaths for any group of lives with the same sex-age-year is binomially distributed, and that the mean of the distribution is given by qCPM. The formula for standard deviation is shown below, by income, where K_i is the annualized income and n_i is the number of annuitants with that income and that sex-age-year. The sum is over all annuitants under consideration. The same formula may be used by count except that K_i is 1 in all cases.

$$\text{Standard Deviation of A/E by Income} = \frac{\left(\sum_i K_i^2 n_i p_i q_i \right)^{0.5}}{\sum_i K_i n_i q_i}$$

4 Overview

All six companies have contributed data for the calendar years 2007 to 2012. The data were subjected to checks to ensure consistency from one year to the next, and corrections were made as needed. All companies have signed off on their data as sufficiently accurate for the purpose of this study. (Data is currently being submitted for 2013 and 2014; a subsequent study is expected.)

The data submitted and study method are very similar to that used by the individual annuitant mortality study. The exception is that this study has also requested industry codes for each group and postal codes for each annuitant. Not all companies are able to provide industry codes or postal codes at this time, and accordingly reporting on these has been deferred until enough companies can include these data.

This study is able to distinguish experience based on sex, year of birth, year of experience, amount of annualized income, whether the pension arises from a DB plan, and whether the annuity is single life or joint.

Each contributing company provided factors to be applied to reported deaths to make an estimate of incurred but not reported deaths (IBNR). All deaths and the annualized income of deaths in this report have been adjusted for IBNR as of the date of the data extract for 2012. The same factor is used for both count and income of deaths. Exposures are not adjusted.

The IBNR factors of the contributing companies are considered confidential. However, table 2 is included in order to give readers an idea of the magnitude of the factors. The table shows the simple average of the IBNR factors for the six contributing companies, combining male and female. For example, deaths on single life annuities submitted three years earlier are increased by 0.8% to allow for IBNR.

Delay	Single	Primary	Secondary
1	5.0%	6.9%	76%
2	1.0%	2.3%	31%
3	0.8%	1.4%	15%
4	0.3%	0.7%	5.9%
5	0.1%	0.2%	1.5%
6	0.1%	0.1%	1.2%

Table 3 compares the exposure and deaths included in this report to the totals from the studies that underlie the construction of the individual mortality table CIP2014 and the private sector pension table CPM2014priv. (Not all ages were actually used in table construction.) The table shows that the group annuitant data set is a sizeable one. Note that the group data includes only six years of experience, compared to 12 years for individual and 10 years for pensioners.

Source	Table	Exposure		Deaths	
		Count	Income	Count	Income
Group Annuitants	none yet	2,287,560	12,517,854	106,425	494,999
Individual Annuitants	CIP2014	3,649,413	14,845,090	225,438	809,949
DB Pensioners (priv)	CPM2014priv	962,899	10,519,535	46,838	372,876

Chart 1 shows the distribution of exposure, by income, into quinquennial age groups. The median age is 75.8 for males and 74.4 for females. There is relatively little exposure other than in the range 60–89. Note that the age distribution for females is slightly flatter than for males.

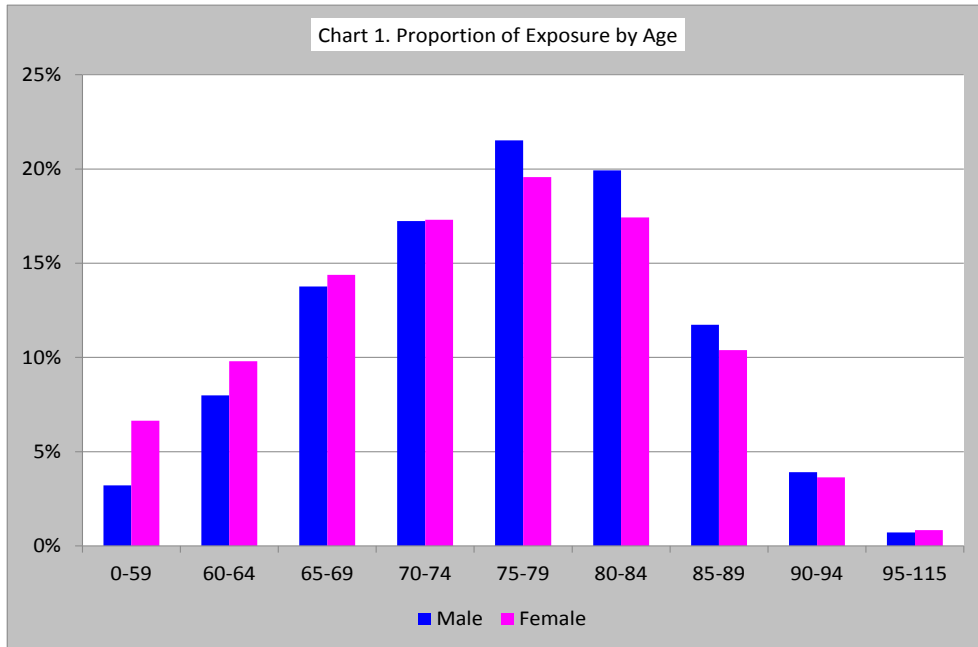


Chart 2 shows the distribution of exposure, by income, over each of the six calendar years included in the study. The distribution is fairly flat, increasing slightly toward the more recent years. The increase is greater for females than for males.

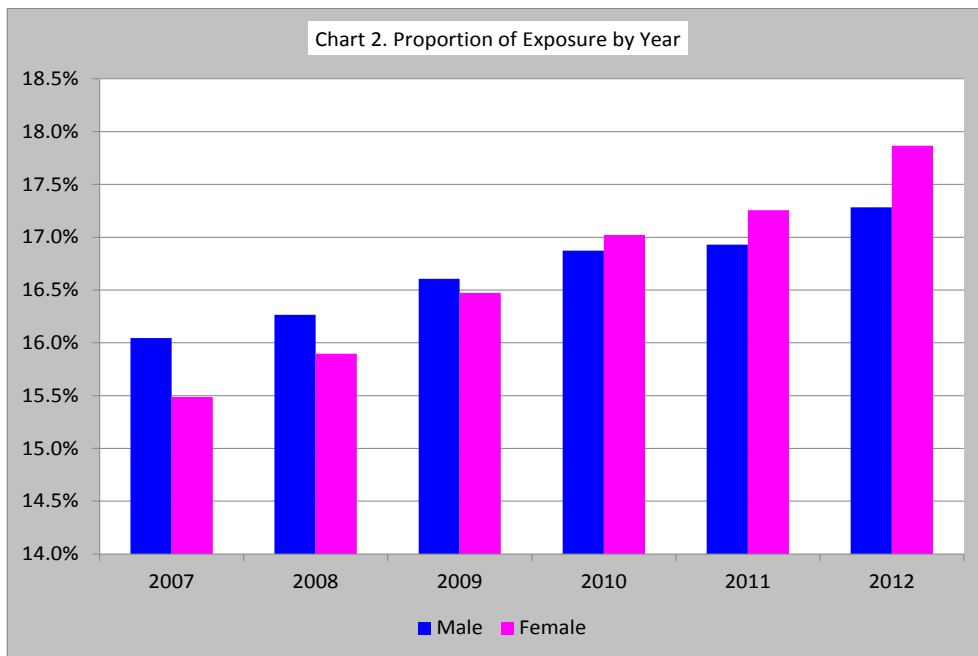


Chart 3 shows the distribution of the annuities in the study by amount of monthly income, weighted by income. As the chart suggests, the average size is in the first income band. The average size for males is \$487 per month and for females, \$423. (However, there may be some small annuities that represent adjustments to the income for a pensioner rather than the full amount of the pension; 14% of annuities are for less than \$50 per month. If these are ignored, the averages increase to \$560 and \$491 for males and females, respectively.) Although there are some large annuities included, the chart shows that small annuities predominate.

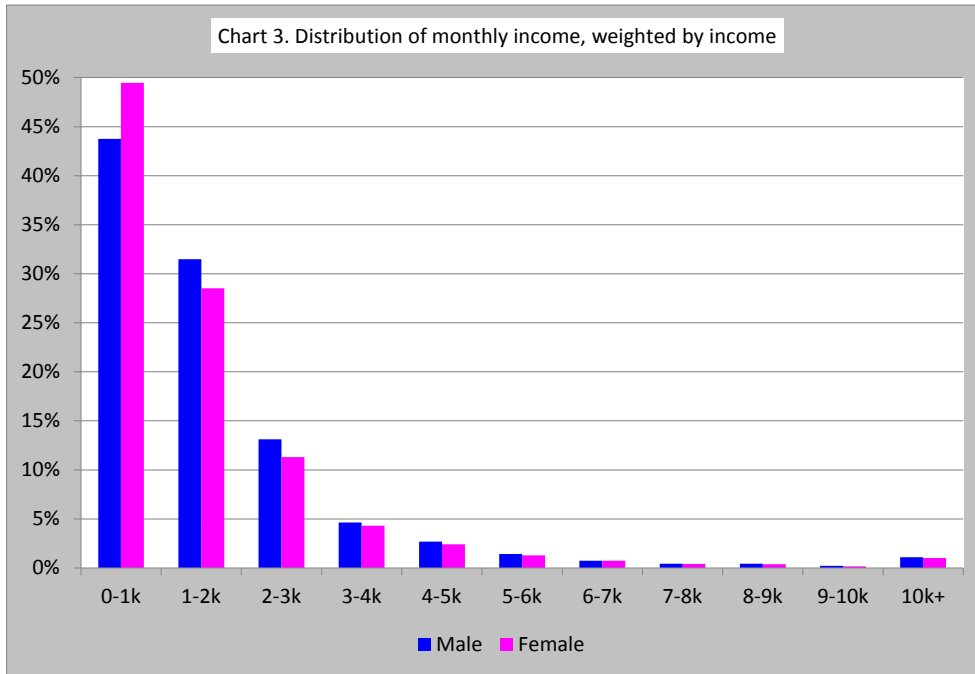


Table 4 shows the summarized experience by quinquennial ages, and table 5 by years of experience. Both show data by income only. If qCPM were a good fit for the mortality experience of this data set, the actual-to-expected (A/E) ratios would be mostly within one or two standard deviations of 100%. In fact they are not, either for males or females, but females are generally closer to 100% than males, although the males are close to 100% for many age ranges.

Table 4. Summarized experience by age. Expected on CPM2014priv with CPM-B. (annualized income in thousands)

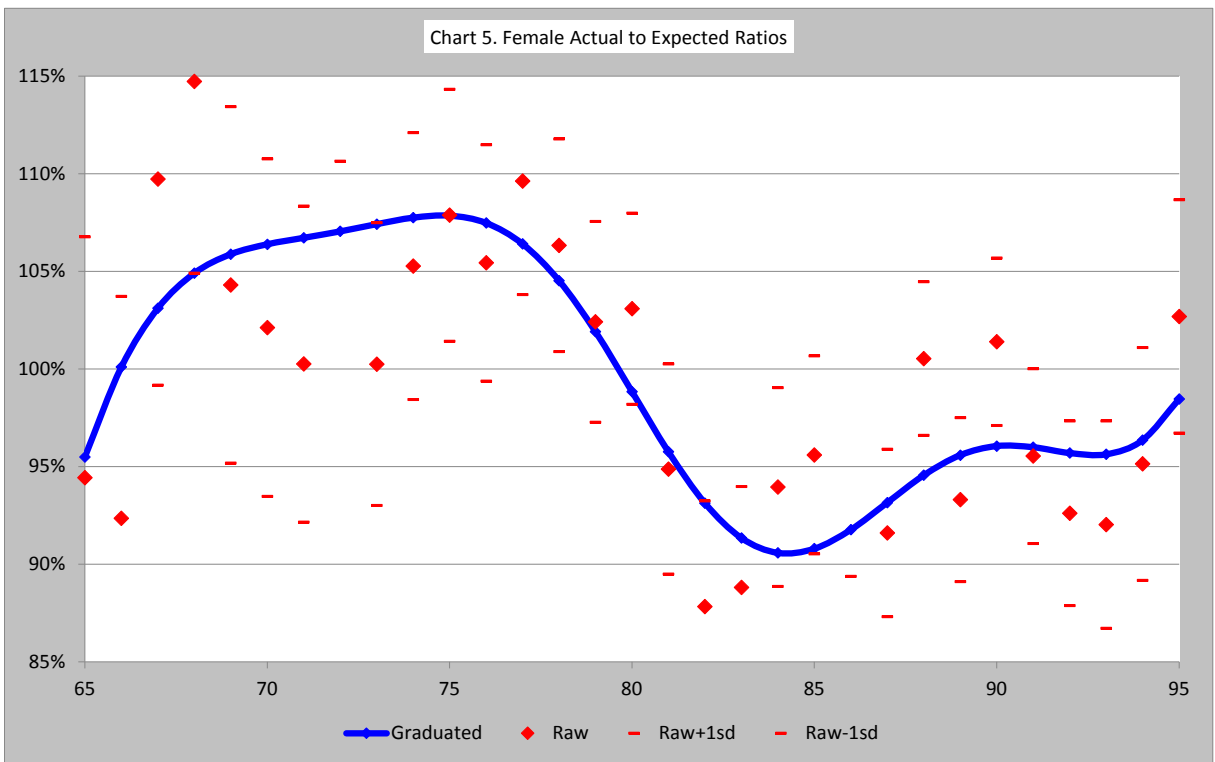
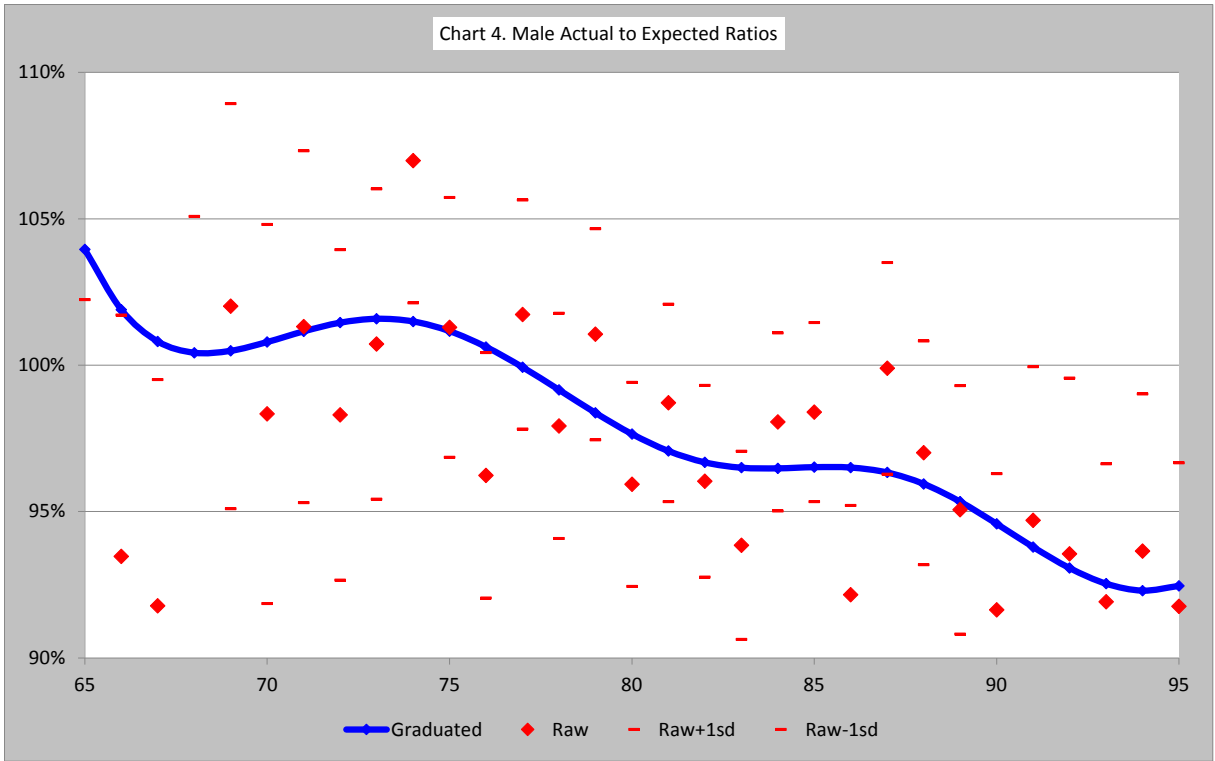
Ages	Exposure		Deaths		Actual/Expected		Standard Deviation	
	Male	Female	Male	Female	Male	Female	Male	Female
0-59	221,216	373,411	1,098	1,282	82.4%	127.3%	11.4%	13.8%
60-64	550,732	550,779	4,245	2,783	78.9%	98.1%	5.7%	7.5%
65-69	949,876	808,413	13,223	6,888	102.2%	104.2%	3.5%	4.7%
70-74	1,188,642	973,001	25,759	13,385	101.7%	105.4%	2.5%	3.4%
75-79	1,484,214	1,099,898	54,581	26,457	99.7%	106.1%	1.8%	2.6%
80-84	1,374,940	979,290	85,311	38,925	96.5%	93.3%	1.5%	2.3%
85-89	809,045	584,182	84,722	42,684	96.5%	92.9%	1.6%	2.1%
90-94	269,730	204,251	44,434	26,578	93.1%	95.9%	2.4%	2.2%
95-115	49,217	47,017	12,151	10,493	82.5%	93.1%	2.9%	3.0%
All	6,897,612	5,620,242	325,523	169,475	96.2%	97.0%	0.8%	1.0%

Table 5. Summarized experience by year. Expected on CPM2014priv with CPM-B. (annualized income in thousands)

Year	Exposure		Deaths		Actual/Expected		Standard Deviation	
	Male	Female	Male	Female	Male	Female	Male	Female
2007	1,106,765	870,463	49,747	24,585	93.4%	97.3%	1.9%	2.6%
2008	1,121,860	893,396	52,277	25,466	95.6%	95.5%	1.9%	2.5%
2009	1,145,343	925,778	53,822	26,675	96.5%	94.4%	1.9%	2.5%
2010	1,163,802	956,648	56,320	29,659	98.3%	98.9%	1.9%	2.4%
2011	1,167,765	969,883	55,133	30,510	95.0%	97.1%	1.9%	2.4%
2012	1,192,076	1,004,074	58,225	32,581	98.1%	98.3%	1.9%	2.4%
All	6,897,612	5,620,242	325,523	169,475	96.2%	97.0%	0.8%	1.0%

Charts 4 (male) and 5 (female) show the actual-to-expected ratios by income for each age in the range 65–95. The blue line is for graduated ratios, the red diamonds show the raw ratios, and the red tick marks show one standard deviation above and below the raw ratios. The graduation was done with Whittaker-Henderson; its purpose is merely to highlight the trend by age, not to suggest a new mortality table.

It is interesting to note that these charts suggest a different relationship than does table 3. The charts suggest that male A/E ratios have a pronounced downward trend with increasing age. The female A/E ratios show more rapid variation by age, particularly in the neighbourhood of age 80.



On the surface, it appears that mortality experience for group annuitants is not dramatically different from qCPM, but there are strong enough differences that qCPM

may not be an appropriate basis for group annuities without some modification. The analyses in the next section attempt to look more deeply into the group annuitant experience to seek an explanation for the differences from qCPM.

5 Analyses

5.1 Single/Joint

The data distinguish three types of annuities: single life, joint life for the primary annuitant, and joint life for the secondary annuitant. (After the death of the primary annuitant, the secondary annuitant, if then living, is thereafter considered the primary annuitant.) Not all companies were able to include data for a secondary annuitant. It was not always possible to distinguish a single surviving annuitant of a joint and last survivor annuity from a single life annuitant, particularly when the insurance company took on the risk after the first death. However, there is no reason to believe that there is enough misrepresentation of the annuity type to invalidate the analysis.

Table 6 summarizes the experience by annuity type. Note that males in joint annuities are rarely the secondary annuitant.

The A/E ratios are lower for secondary annuitants than for primary, but not by enough that one can claim the difference to be strongly significant statistically. There may be an explanation related to the delay in reporting deaths. The deaths of secondary annuitants are often not reported until the death of the primary. The actual deaths have already been adjusted for an estimate of IBNR, and the adjustments are larger for secondary annuitants than for other categories. However, it may be that the IBNR adjustment is not sufficient for secondary annuitants. The contributing companies will be able to refine the estimates over time.

Type	Exposure		Deaths		Actual/Expected		Standard Deviation	
	Male	Female	Male	Female	Male	Female	Male	Female
Single	2,758,820	1,649,966	157,076	78,601	99.6%	103.7%	0.9%	1.1%
Joint primary	3,888,888	999,048	161,026	35,549	94.2%	95.3%	1.1%	2.6%
Joint secondary	249,904	2,971,229	7,421	55,325	76.2%	89.8%	9.9%	1.9%
All	6,897,612	5,620,242	325,523	169,475	96.2%	97.0%	0.8%	1.0%

5.2 Defined Benefit or not

The data distinguishes three types of pension plans: defined benefit (DB), other types (not DB) such as defined contribution and group registered retirement savings plan (RRSP), and type unknown. "Unknown" was used by a company when its administrative system did not have the pension plan type.

Table 7 summarizes mortality experience by pension plan type. Unfortunately there is so much "unknown" that little can be inferred.

Table 7. Summarized experience by pension plan type. Expected on CPM2014priv with CPM-B. (annualized income in thousands)

Plan	Exposure		Deaths		Actual/Expected		Standard Deviation	
	Male	Female	Male	Female	Male	Female	Male	Female
DB	2,999,981	2,566,873	136,600	68,025	98.8%	96.5%	1.2%	1.6%
not DB	915,528	799,644	47,447	27,158	95.9%	100.4%	1.7%	2.2%
Unknown	2,982,103	2,253,724	141,476	74,292	93.9%	96.2%	1.2%	1.6%
All	6,897,612	5,620,242	325,523	169,475	96.2%	97.0%	0.8%	1.0%

5.3 Size of Income

The data underlying CPM2014 showed a strong correlation between the level of mortality and the size of the pension, so much so that size adjustment factors were published along with the CPM2014 tables. It is important to discern if the group annuity data show a similar relationship.

Table 8 shows the experience by income band. Each band is shown as \$500 wide in monthly income as of 2014. Like the CPM report, the bands are adjusted approximately based on the average weekly earnings (AWE). The CPM report suggests that AWE was about 90% during 2007–2012 of what it was in 2014. Accordingly, the first income band is actually of monthly amounts of 0–\$449, the second \$450–899, etc. This adjustment to the bands was used for all years of experience. It was not convenient to reflect the variation in AWE year by year as was done in CPM. The expected mortality in table 6, like all prior tables and charts, is on qCPM with no size adjustment.

As indicated by the standard deviations, little can be inferred for the higher bands, but the lower bands show a strong decreasing trend with increasing income.

Income	Exposure		Deaths		Actual/Expected		Standard Deviation	
	Male	Female	Male	Female	Male	Female	Male	Female
0-499	1,488,235	1,480,484	85,218	57,391	105.4%	104.1%	0.6%	0.7%
500-999	1,529,604	1,300,029	82,415	42,447	103.9%	102.0%	0.9%	1.3%
1000-1499	1,321,196	989,499	56,367	24,508	99.2%	96.3%	1.5%	2.2%
1500-1999	850,623	613,270	32,601	14,960	90.2%	93.0%	2.2%	3.3%
2000-2499	645,264	437,157	22,686	9,606	82.7%	86.1%	2.8%	4.5%
2500-2999	260,317	198,314	11,368	5,260	91.9%	90.1%	4.7%	6.8%
3000-3499	180,368	138,429	7,631	3,656	91.1%	89.8%	6.2%	8.9%
3500-3999	138,549	103,089	4,893	2,405	70.9%	88.1%	7.3%	11.8%
4000-4499	105,790	80,263	3,868	1,724	70.9%	71.5%	8.8%	13.4%
4500-4999	78,691	54,796	3,205	1,439	85.2%	88.4%	11.2%	17.2%
5000-5499	58,045	43,372	3,371	1,238	101.9%	80.2%	12.4%	18.4%
5500-5999	40,089	29,135	1,911	1,166	79.7%	112.1%	15.3%	23.5%
6000+	200,842	152,404	9,989	3,677	65.6%	60.4%	10.3%	17.0%
All	6,897,612	5,620,242	325,523	169,475	96.2%	97.0%	0.8%	1.0%

Chart 6 shows the A/E ratios graphically. The downward slope is quite evident. The slope for males appears to be slightly steeper than for females, but the difference may not be statistically significant.

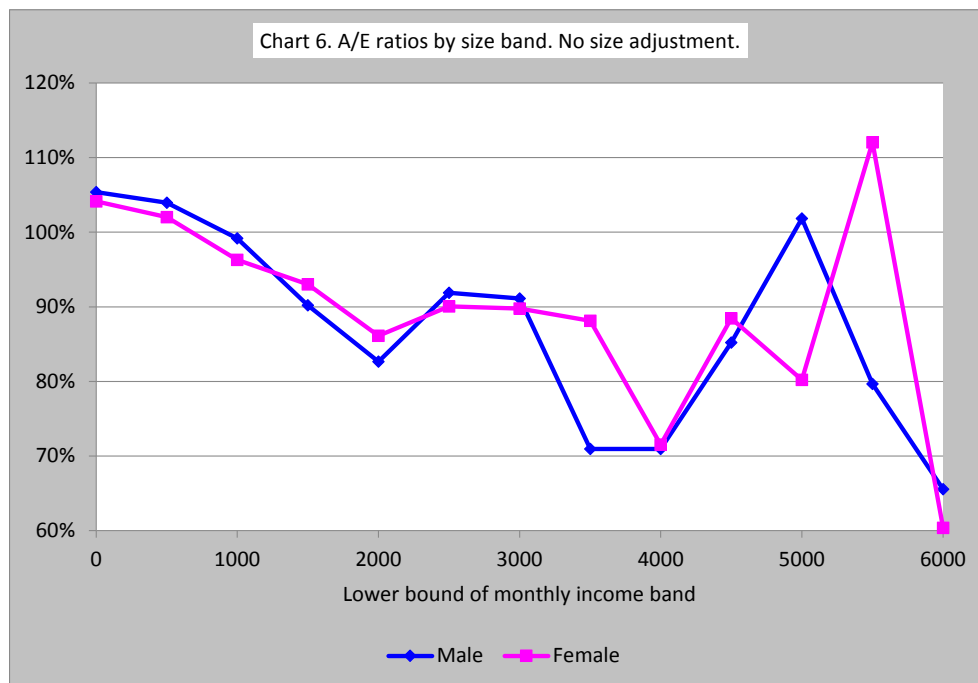
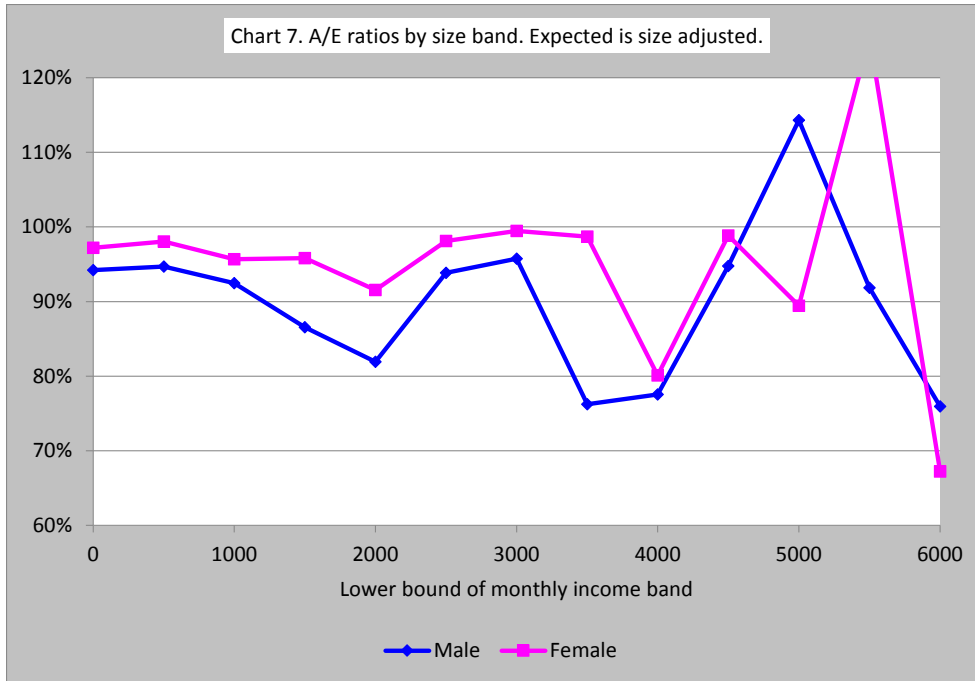


Table 9 is similar to table 8 except that the expected mortality rates have been size adjusted using the factors published with CPM2014priv. If the size adjustment factors were appropriate for the group annuitant data, the A/E ratios would be very flat in table 9.

Table 9. Summarized experience by monthly income range. Expected on CPM2014priv with CPM-B with size adjustments. (annualized income in thousands)								
Income	Exposure		Deaths		Actual/Expected		Standard Deviation	
	Male	Female	Male	Female	Male	Female	Male	Female
0-499	1,488,235	1,480,484	85,218	57,391	94.2%	97.2%	0.5%	0.7%
500-999	1,529,604	1,300,029	82,415	42,447	94.7%	98.1%	0.9%	1.3%
1000-1499	1,321,196	989,499	56,367	24,508	92.5%	95.7%	1.4%	2.2%
1500-1999	850,623	613,270	32,601	14,960	86.5%	95.8%	2.1%	3.4%
2000-2499	645,264	437,157	22,686	9,606	81.9%	91.5%	2.8%	4.6%
2500-2999	260,317	198,314	11,368	5,260	93.9%	98.1%	4.7%	7.1%
3000-3499	180,368	138,429	7,631	3,656	95.8%	99.5%	6.3%	9.4%
3500-3999	138,549	103,089	4,893	2,405	76.2%	98.7%	7.6%	12.5%
4000-4499	105,790	80,263	3,868	1,724	77.5%	80.1%	9.2%	14.2%
4500-4999	78,691	54,796	3,205	1,439	94.8%	98.8%	11.9%	18.2%
5000-5499	58,045	43,372	3,371	1,238	114.3%	89.4%	13.2%	19.5%
5500-5999	40,089	29,135	1,911	1,166	91.9%	125.5%	16.5%	25.0%
6000+	200,842	152,404	9,989	3,677	75.9%	67.2%	11.2%	17.9%
All	6,897,612	5,620,242	325,523	169,475	91.2%	95.8%	0.7%	1.0%

Chart 7 shows the A/E ratios of table 9 graphically. It is clear that the line is fairly flat for females under the \$4000–4499 band. The trend is less clear for males, but a downward slope is suggested. A downward slope would imply that the variation by size is greater than that observed in the CPM study.



It is important to state that the relationship between the level of mortality and the amount of pension income is one of correlation not causality. There are many objections that can be raised to size adjustments. For example, one would not expect different mortality for two men who are otherwise very similar but one worked for 40 years under one pension plan and the other spent 10 years under each of four different plans, but size adjustments suggest heavier mortality for the latter.

This study does not allow us any insight into the individual circumstances of pensioners beyond the demographic data submitted. Nonetheless, it is clearly in the data that mortality rates go down dramatically as income goes up, at least over the range for which there is an abundance of data. Actuaries may be advised to be alert to possible applications of the size relationship, but whether a size adjustment is appropriate in a particular case is beyond the scope of this study.

5.4 Duration from Retirement

In most cases, the contributing companies are not able to determine the date of retirement. The recorded date of issue relates to when the company took on the risk; in the case of a de-risking strategy by the plan trustees, that date may be many years after retirement. Accordingly, duration from the issue of the annuitant is not relevant and is not studied in this report.

6 Supplementary Information

For those who wish to study the data further on their own, a tool used in developing this report is available for download. That tool is an Excel workbook and a binary file

containing the summarized intercompany data. These two files and a text file with installation instructions are combined into a .zip file which is available [here](#).

7 Subcommittee

The Pension and Group Annuity Experience Subcommittee of the Research Committee is responsible for the content of this report. The members of the subcommittee that participated in the review of this report are listed below. Bob Howard was engaged by the CIA to compile the data for the report on behalf of the subcommittee.

Claire Bilodeau
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Andrew Kugler
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