Canadian Institute of Actuaries | Institut canadien des actuaires

*Research report*

# Canadian Individual Life Experience for Policy Year 2018–2019

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# 1 Executive Summary

This is the 70th annual report of the intercompany mortality experience for Canadian individual life insurance policies. The study covers the one-year period beginning with the policy anniversary in 2018 on an age-nearest-birthday basis.

The main things to note are that mortality improvement has continued (Section 5) except in the case of female smokers, that the decrease in mortality with increasing size of policy face amount remains significant (Section 4.4), and that the experience for preferred and residual are closer together than one might expect (Section 4.3).

The study this year has a number of changes from prior studies.

1. The name of the report has changed to reflect current usage; it was previously called "Canadian Standard Ordinary Life Experience".
2. Over half of the data now include province of residence; see Section 4.6.
3. After an absence of five years, cause of death is again part of the data submitted, although not all contributing companies were able to provide cause of death at this time. Of the cases for which a cause of death (Section 4.7) is identified, cancer is the leading cause with 51% of deaths, by amount, followed by heart disease at 19%.
4. Records are now submitted for substandard policies, if the rating is a multiple of standard rates; substandard experience is included only in Section 4.8.
5. Data over attained age 100 are not included because they are considered unreliable (Section 4.9). Previously records were included to age 120.

The amount of insurance in the study continues to grow. It is 27% larger than four years ago. The data included represent a significant proportion of the population of Canada.

**Note: This document has been updated since its original release with corrections to the databases and the tables accompanying this report. Section 7 describes the updates made and is the only part of the report that was changed since original release.*

# 2 Table of Contents

# 3 Data and Method

## 3.1 Overview

This study has been called “standard ordinary” for 69 years, but its name has been changed now to “individual” to reflect more common terminology. “Standard” was dropped because the data collected are broader than standard, but the study continues to show experience exclusively for standard policies unless otherwise stated.

Records were submitted by eight companies for individual life policies and riders issued in Canada. The submissions include business issued as joint, converted, substandard, simplified issue, and guaranteed issue, but all of these categories are excluded from the main study. The records included are for single life policies that required normal underwriting and excluding business rated as substandard. Records for attained ages over 100 are excluded (see Section 4.9).

This report includes an analysis of substandard business compared to standard in Section 4.8. It is expected that in future years analyses of simplified and guaranteed issue policies, converted policies, and joint policies will be included, but in this report these are always excluded.

There were a total of 13.2 million records submitted for the 2018–2019 policy year, with a total face amount of $2.28 trillion. Included in the total was $0.19 trillion of insurance on new issues of 2018. (According to CLHIA the total individual insurance industry included $3.06 trillion, and according to LIMRA, the sales of 2018 were $0.25 trillion.) Thus the data submitted include about three-quarters of the industry face amount.

Table 1 shows the quantity of data, both exposure and deaths, included in this study and in the previous four.

**Table 1. Totals included in the study**

| Policy Year of Study | Exposure | | Deaths | |
|---|---|---|---|---|
| | Policies | Amount k$ | Policies | Amount k$ |
| 2014–2015 | 8,632,273 | 1,498,521,212 | 69,435 | 3,068,637 |
| 2015–2016 | 9,027,113 | 1,565,230,017 | 68,458 | 3,095,533 |
| 2016–2017 | 8,497,829 | 1,493,924,827 | 68,056 | 2,980,574 |
| 2017–2018 | 9,058,927 | 1,730,483,682 | 72,229 | 3,572,599 |
| 2018–2019 | 9,239,176 | 1,819,102,019 | 71,756 | 3,548,157 |
| Total | 44,455,319 | 8,107,261,757 | 349,933 | 16,265,500 |

The numbers for the previous studies are adjusted to be consistent with the method used in this study. The impact is too small to warrant highlighting it here. More detail on the method can be found in Appendix 1.

To put the size of this dataset in perspective, one should note that according to Statistics Canada, at the beginning of 2019 the population of Canada was estimated at 37.6 million, and the number of deaths in the 12 months centred on that date was 281,000. Therefore, the study for the 2018–2019 policy year (also centred on the beginning of 2019) includes as much as one-quarter of the population of Canada. This is an upper limit because some people may have

more than one policy in the study, and the profile of the insured lives may be quite different from that of the population.

## 3.2 Contributing companies

Table 2 lists the contributing companies in the current and previous studies. The percentages shown are the proportion of the total exposure that was submitted by each company, calculated by amount.

**Table 2. Contributing companies**

| Company | Exposure %, by amount | |
|---|---|---|
| | 2017–2018 | 2018–2019 |
| Canada Life | 24.6% | 23.4% |
| Desjardins | 3.6% | 4.8% |
| Equitable Life | 5.1% | 5.4% |
| Industrial-Alliance | 12.3% | 12.3% |
| ivari | 9.9% | 10.1% |
| Manulife | 21.5% | 20.9% |
| RBC Life | 6.2% | 6.2% |
| Sun Life | 16.9% | 16.8% |
| Total exposure by amount | 100.0% | 100.0% |

On behalf of the Canadian Institute of Actuaries (CIA), we thank these companies for their willingness to contribute, for the effort expended, and for their care to maintain the quality of the study.

Of course, not all companies have the same experience. However, this year the actual to expected (A/E) ratios on CIA9704 by company were more closely grouped than usual. All companies were within 5% of the intercompany A/E ratio. In comparison, only three of eight companies were within 5% last year.

# 4 Experience for Policy Year 2018–2019

## 4.1 Overall results

Table 3 shows the overall results for all lives included in the study. Note that this table is comprised of three sections: select experience by policy year, select experience by issue age, and ultimate experience (based on 15-year select[1]) by attained age. So the first two sections cover the same experience but group the data differently. Standard deviations are calculated on CIA9704 only. If calculated on CIA8692 they would be proportionately smaller because of the A/E ratios being smaller on CIA8692. Tables 4 and 5 present the same data as Table 3, but split between females in Table 4 and males in Table 5 (in alphabetical order).

It is evident that experience is significantly different both from CIA9704 and from CIA8692. Not only is the overall level far from 100% of either table, but the variation in A/E ratios by age group is substantial, especially in the ultimate period.

Incidentally, the Experience Research Committee (ERC) has an active project to construct a new mortality table. That new table will be used in future studies after it is available.

[1] The select period was set at 15 years because both mortality tables for calculating expected deaths have a 15-year select period. For juvenile ages the mortality rates in both tables vary by attained age rather than issue age and duration, with a few exceptions.

| **Table 3. Experience for all data included in the study for policy year 2018–2019** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CIA9704 | | | | CIA8692 | | Exposure | | Actual deaths | |
| | Act/Exp | | Std Dev | | Act/Exp | | | | | |
| | Pols | Amt | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| *Select by policy year* | | | | | | | | | | |
| 1st | 72.5% | 68.0% | 6.4% | 18.2% | 50.1% | 47.6% | 352.7 | 148,486 | 114 | 39,697 |
| 2nd | 84.1% | 61.9% | 4.9% | 12.9% | 68.4% | 48.4% | 350.3 | 145,557 | 223 | 53,411 |
| 3rd | 67.0% | 48.9% | 4.3% | 11.5% | 54.4% | 37.9% | 382.9 | 160,605 | 235 | 58,391 |
| 4th | 64.2% | 56.9% | 4.1% | 10.9% | 52.0% | 43.6% | 338.2 | 136,272 | 239 | 68,684 |
| 5th | 73.5% | 62.6% | 3.9% | 11.7% | 58.7% | 47.4% | 303.0 | 117,910 | 303 | 80,089 |
| 6–10th | 65.8% | 50.7% | 1.5% | 3.6% | 49.9% | 36.9% | 1 460.2 | 500,288 | 1,964 | 403,823 |
| 11–15th | 70.3% | 60.1% | 1.4% | 4.6% | 50.3% | 42.1% | 969.9 | 223,911 | 2,217 | 344,233 |
| *Subtot* | 68.8% | 55.7% | 0.9% | 2.6% | 51.4% | 40.6% | 4 157.2 | 1,433,030 | 5,295 | 1,048,326 |
| *Select by issue age* | | | | | | | | | | |
| 0–9 | 73.1% | 66.4% | 10.8% | 35.5% | 44.0% | 39.7% | 421.9 | 48,165 | 47 | 4,711 |
| 10–19 | 94.6% | 79.2% | 9.3% | 35.0% | 61.4% | 50.4% | 220.5 | 36,411 | 73 | 9,548 |
| 20–29 | 66.1% | 60.3% | 4.6% | 9.4% | 47.4% | 43.8% | 683.4 | 204,715 | 200 | 51,453 |
| 30–39 | 70.9% | 61.7% | 2.8% | 4.7% | 49.4% | 43.4% | 1 187.9 | 540,750 | 573 | 205,627 |
| 40–49 | 68.4% | 60.5% | 2.1% | 4.7% | 48.1% | 41.6% | 922.7 | 403,669 | 994 | 311,322 |
| 50–59 | 59.3% | 48.3% | 1.7% | 5.0% | 46.8% | 36.5% | 516.1 | 162,787 | 1,304 | 249,206 |
| 60–69 | 67.4% | 42.3% | 1.8% | 7.2% | 51.8% | 33.0% | 176.5 | 32,562 | 1,288 | 118,866 |
| 70–79 | 85.7% | 62.1% | 2.9% | 15.4% | 63.3% | 46.9% | 26.2 | 3,724 | 629 | 68,144 |
| 80–100 | 129.7% | 135.8% | 6.5% | 24.0% | 110.7% | 118.5% | 2.1 | 247 | 190 | 29,450 |
| *Subtot* | 68.8% | 55.7% | 0.9% | 2.6% | 51.4% | 40.6% | 4 157.2 | 1,433,030 | 5,295 | 1,048,326 |
| *Ultimate by attained age* | | | | | | | | | | |
| 15–19 | 69.6% | 71.1% | 18.7% | 45.4% | 38.3% | 39.2% | 65.1 | 4,223 | 14 | 915 |
| 20–29 | 102.3% | 87.5% | 6.6% | 17.3% | 75.7% | 64.7% | 307.8 | 18,198 | 162 | 8,081 |
| 30–39 | 100.8% | 81.1% | 4.8% | 16.5% | 64.8% | 52.7% | 428.4 | 24,132 | 308 | 13,426 |
| 40–49 | 103.9% | 117.6% | 2.9% | 6.4% | 65.8% | 75.6% | 646.0 | 60,338 | 834 | 85,892 |
| 50–59 | 82.7% | 74.6% | 1.3% | 3.0% | 55.0% | 47.7% | 1 147.0 | 125,385 | 3,130 | 273,544 |
| 60–69 | 66.9% | 58.7% | 0.7% | 1.9% | 51.4% | 43.1% | 1 215.5 | 98,709 | 8,228 | 515,205 |
| 70–79 | 75.9% | 61.0% | 0.6% | 2.0% | 54.0% | 42.2% | 788.3 | 39,370 | 15,195 | 563,878 |
| 80–89 | 90.2% | 77.5% | 0.5% | 2.5% | 67.1% | 56.2% | 388.6 | 13,253 | 24,120 | 681,838 |
| 90–100 | 77.1% | 75.0% | 0.6% | 3.1% | 74.2% | 73.1% | 95.3 | 2,464 | 14,471 | 357,051 |
| *Subtot* | 80.2% | 69.0% | 0.3% | 1.1% | 61.9% | 50.4% | 5 082.0 | 386,072 | 66,461 | 2,499,831 |
| **Total** | 79.2% | 64.4% | 0.3% | 1.1% | 61.0% | 47.0% | 9 239.2 | 1,819,102 | 71,756 | 3,548,157 |

| **Table 4. Experience for all females included in the study for policy year 2018–2019** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CIA9704 | | | | CIA86-92 | | Exposure | | Actual deaths | |
| | Act/Exp | | Std Dev | | Act/Exp | | | | | |
| | Pols | Amt | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| *Select by policy year* | | | | | | | | | | |
| 1st | 66.0% | 88.5% | 11.4% | 30.2% | 39.2% | 51.5% | 172.3 | 63,566 | 34 | 12,758 |
| 2nd | 67.5% | 43.7% | 8.1% | 21.9% | 55.6% | 34.4% | 170.8 | 62,539 | 69 | 11,309 |
| 3rd | 67.2% | 47.7% | 6.9% | 18.7% | 56.8% | 38.2% | 187.5 | 69,547 | 94 | 18,212 |
| 4th | 55.8% | 38.7% | 6.6% | 18.1% | 47.8% | 31.4% | 165.9 | 58,454 | 85 | 14,940 |
| 5th | 76.1% | 71.7% | 6.3% | 21.1% | 64.7% | 58.1% | 148.0 | 50,051 | 129 | 30,211 |
| 6–10th | 64.4% | 47.4% | 2.3% | 5.4% | 52.4% | 37.6% | 720.4 | 210,520 | 787 | 121,566 |
| 11–15th | 74.0% | 64.0% | 2.1% | 6.9% | 56.0% | 48.4% | 496.0 | 99,295 | 1,059 | 138,415 |
| *Subtot* | 69.1% | 55.0% | 1.4% | 4.0% | 54.4% | 42.7% | 2,060.9 | 613,973 | 2,257 | 347,412 |
| *Select by issue age* | | | | | | | | | | |
| 0–9 | 72.6% | 56.6% | 17.9% | 62.4% | 45.4% | 35.2% | 207.9 | 24,298 | 18 | 1,631 |
| 10–19 | 124.1% | 105.6% | 19.0% | 62.4% | 81.0% | 67.7% | 106.2 | 17,787 | 25 | 3,357 |
| 20–29 | 72.4% | 69.4% | 7.8% | 13.5% | 50.7% | 49.3% | 368.2 | 106,025 | 77 | 19,374 |
| 30–39 | 73.4% | 62.5% | 4.6% | 6.9% | 51.3% | 43.7% | 596.9 | 240,560 | 233 | 68,873 |
| 40–49 | 66.4% | 56.7% | 3.4% | 7.9% | 52.7% | 43.7% | 436.5 | 155,293 | 402 | 94,102 |
| 50–59 | 57.7% | 42.0% | 2.7% | 7.8% | 51.2% | 36.6% | 239.4 | 55,510 | 528 | 64,642 |
| 60–69 | 69.6% | 36.1% | 2.8% | 11.5% | 54.2% | 28.8% | 89.4 | 12,129 | 569 | 33,683 |
| 70–79 | 81.0% | 68.7% | 4.1% | 18.9% | 58.3% | 50.3% | 15.2 | 2,175 | 308 | 39,535 |
| 80–100 | 117.3% | 128.8% | 8.5% | 28.1% | 97.1% | 110.6% | 1.2 | 196 | 99 | 22,216 |
| *Subtot* | 69.1% | 55.0% | 1.4% | 4.0% | 54.4% | 42.7% | 2,060.9 | 613,973 | 2,257 | 347,412 |
| *Ultimate by attained age* | | | | | | | | | | |
| 15–19 | 75.7% | 48.5% | 37.0% | 74.9% | 43.6% | 27.9% | 32.2 | 2,148 | 5 | 191 |
| 20–29 | 106.5% | 97.8% | 13.2% | 40.8% | 80.6% | 74.0% | 152.3 | 9,234 | 48 | 2,660 |
| 30–39 | 95.2% | 74.9% | 8.9% | 23.6% | 56.7% | 46.4% | 209.8 | 11,739 | 95 | 4,051 |
| 40–49 | 97.1% | 84.2% | 4.6% | 9.5% | 61.1% | 55.0% | 326.5 | 29,054 | 326 | 24,137 |
| 50–59 | 77.2% | 77.0% | 2.1% | 4.3% | 60.9% | 58.9% | 559.8 | 51,581 | 1,269 | 100,288 |
| 60–69 | 65.6% | 59.4% | 1.2% | 3.0% | 59.8% | 50.9% | 557.4 | 35,411 | 3,116 | 149,197 |
| 70–79 | 84.7% | 71.4% | 1.1% | 3.6% | 61.9% | 50.3% | 342.4 | 12,695 | 5,437 | 150,122 |
| 80–89 | 99.1% | 83.7% | 0.9% | 4.9% | 72.0% | 59.2% | 171.7 | 4,812 | 9,120 | 205,478 |
| 90–100 | 83.3% | 80.7% | 0.9% | 3.9% | 74.8% | 73.5% | 49.2 | 1,141 | 6,834 | 150,356 |
| *Subtot* | 85.5% | 74.1% | 0.5% | 1.8% | 67.9% | 57.4% | 2,401.1 | 157,812 | 26,248 | 786,480 |
| **Total** | 83.9% | 67.0% | 0.5% | 1.9% | 66.6% | 51.9% | 4,462.0 | 771,785 | 28,505 | 1,133,892 |

| Table 5. Experience for all males included in the study for policy year 2018–2019 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CIA9704 | | | | CIA86-92 | | Exposure | | Actual deaths | |
| | Act/Exp | | Std Dev | | Act/Exp | | | | | |
| | Pols | Amt | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| *Select by policy year* | | | | | | | | | | |
| 1st | 75.6% | 61.3% | 7.7% | 22.0% | 56.7% | 45.9% | 180.5 | 84,921 | 80 | 26,938 |
| 2nd | 94.6% | 69.6% | 6.2% | 15.9% | 76.3% | 54.4% | 179.4 | 83,018 | 154 | 42,102 |
| 3rd | 66.9% | 49.5% | 5.4% | 14.4% | 53.0% | 37.8% | 195.4 | 91,058 | 141 | 40,179 |
| 4th | 70.1% | 65.4% | 5.3% | 13.5% | 54.6% | 48.9% | 172.2 | 77,818 | 154 | 53,744 |
| 5th | 71.7% | 58.2% | 5.0% | 14.1% | 54.9% | 42.6% | 155.0 | 67,858 | 174 | 49,877 |
| 6–10th | 66.8% | 52.3% | 1.9% | 4.6% | 48.4% | 36.7% | 739.8 | 289,768 | 1,177 | 282,256 |
| 11–15th | 67.2% | 57.8% | 1.9% | 6.0% | 46.0% | 38.7% | 473.9 | 124,616 | 1,158 | 205,817 |
| *Subtot* | 68.6% | 56.1% | 1.2% | 3.3% | 49.3% | 39.6% | 2,096.3 | 819,057 | 3,038 | 700,914 |
| *Select by issue age* | | | | | | | | | | |
| 0–9 | 73.4% | 73.1% | 13.4% | 41.8% | 43.2% | 42.5% | 214.0 | 23,868 | 29 | 3,079 |
| 10–19 | 84.2% | 69.7% | 10.6% | 42.0% | 54.5% | 44.2% | 114.2 | 18,624 | 48 | 6,191 |
| 20–29 | 62.7% | 55.8% | 5.6% | 12.3% | 45.5% | 41.0% | 315.3 | 98,690 | 123 | 32,080 |
| 30–39 | 69.3% | 61.4% | 3.5% | 6.1% | 48.2% | 43.3% | 590.9 | 300,190 | 341 | 136,754 |
| 40–49 | 69.8% | 62.3% | 2.7% | 5.8% | 45.4% | 40.7% | 486.2 | 248,376 | 592 | 217,220 |
| 50–59 | 60.4% | 50.9% | 2.2% | 6.4% | 44.2% | 36.4% | 276.7 | 107,277 | 776 | 184,564 |
| 60–69 | 65.7% | 45.3% | 2.4% | 9.2% | 50.1% | 35.1% | 87.1 | 20,433 | 719 | 85,183 |
| 70–79 | 90.8% | 54.8% | 4.2% | 24.7% | 69.0% | 42.9% | 11.0 | 1,549 | 321 | 28,609 |
| 80–100 | 146.4% | 163.2% | 10.0% | 42.6% | 130.4% | 151.7% | 0.9 | 51 | 91 | 7,234 |
| *Subtot* | 68.6% | 56.1% | 1.2% | 3.3% | 49.3% | 39.6% | 2,096.3 | 819,057 | 3,038 | 700,914 |
| *Ultimate by attained age* | | | | | | | | | | |
| 15–19 | 67.0% | 81.1% | 21.5% | 56.4% | 36.2% | 43.9% | 32.9 | 2,075 | 10 | 724 |
| 20–29 | 100.7% | 83.2% | 7.6% | 17.5% | 73.8% | 60.9% | 155.6 | 8,964 | 114 | 5,421 |
| 30–39 | 103.5% | 84.0% | 5.6% | 21.7% | 69.1% | 56.0% | 218.7 | 12,393 | 213 | 9,374 |
| 40–49 | 108.8% | 139.1% | 3.7% | 8.6% | 69.3% | 88.5% | 319.5 | 31,284 | 508 | 61,755 |
| 50–59 | 87.0% | 73.3% | 1.7% | 4.0% | 51.6% | 42.9% | 587.2 | 73,803 | 1,861 | 173,256 |
| 60–69 | 67.8% | 58.5% | 0.9% | 2.4% | 47.3% | 40.6% | 658.1 | 63,299 | 5,112 | 366,008 |
| 70–79 | 71.8% | 57.9% | 0.7% | 2.4% | 50.4% | 39.9% | 445.9 | 26,676 | 9,759 | 413,756 |
| 80–89 | 85.5% | 75.1% | 0.6% | 2.9% | 64.4% | 55.0% | 216.9 | 8,442 | 15,001 | 476,361 |
| 90–100 | 72.3% | 71.4% | 0.7% | 4.4% | 73.7% | 72.9% | 46.1 | 1,324 | 7,637 | 206,695 |
| *Subtot* | 77.1% | 66.8% | 0.3% | 1.3% | 58.6% | 47.7% | 2,680.9 | 228,260 | 40,213 | 1,713,351 |
| **Total** | 76.4% | 63.3% | 0.3% | 1.4% | 57.8% | 45.1% | 4,777.2 | 1,047,317 | 43,251 | 2,414,265 |

A few of the numbers in the above tables are influenced by very large death claims. *Female select ages 80–100* includes a $10 million claim, almost half the total death claims for that age group. *Male select ages 80–100* includes a $4.5 million claim, over half the total for the age

group. *Male ultimate ages 40–49* includes four policies on the same life for claims of almost $20 million, almost one-third of the total for the age group.

Later tables in this report show A/E ratios on CIA9704 only, and not on CIA8692. However, all tables in the Excel workbook associated with this study calculate A/E on both mortality tables.

## 4.2 Distinguishing by smoking status

Table 6 shows the experience for each sex and each smoking status. Note that the A/E ratio for female smokers is much higher than for the others. Little can be said about smoking unknown in the select period because the variability is too high; note the large standard deviations, particularly by amount. For attained ages under 16, all experience is included under *Smoking unknown*. For all issue ages, smoking is shown as submitted when attained age exceeds 15.

**Table 6. Summary of experience, by sex and smoking, policy year 2018–2019. Expected mortality on CIA9704**

| Risk Class | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
|---|---|---|---|---|---|---|---|---|
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Select experience | | | | | | | | |
| Female non-smoker | 65.9% | 54.0% | 1.5% | 4.2% | 1,656.5 | 553,068 | 1,723 | 301,576 |
| Female smoker | 76.0% | 62.7% | 3.9% | 14.4% | 170.9 | 32,398 | 428 | 44,148 |
| Female unknown | 117.1% | 47.7% | 9.2% | 59.6% | 233.5 | 28,507 | 106 | 1,688 |
| Male non-smoker | 64.9% | 57.1% | 1.4% | 3.6% | 1,612.2 | 724,088 | 2,156 | 613,956 |
| Male smoker | 67.1% | 49.2% | 2.5% | 7.7% | 242.1 | 66,753 | 627 | 83,420 |
| Male unknown | 150.3% | 62.7% | 6.4% | 40.7% | 242.0 | 28,216 | 255 | 3,538 |
| All | 68.8% | 55.7% | 0.9% | 2.6% | 4,157.2 | 1,433,030 | 5,295 | 1,048,326 |
| Ultimate experience | | | | | | | | |
| Female non-smoker | 79.5% | 68.2% | 0.7% | 2.3% | 1,243.5 | 118,481 | 9,576 | 521,062 |
| Female smoker | 103.7% | 99.5% | 1.5% | 3.6% | 437.6 | 21,857 | 4,068 | 143,588 |
| Female unknown | 85.5% | 79.8% | 0.7% | 1.9% | 720.0 | 17,474 | 12,604 | 121,829 |
| Male non-smoker | 75.5% | 65.0% | 0.6% | 1.9% | 1,255.5 | 172,742 | 11,856 | 1,093,083 |
| Male smoker | 77.3% | 67.3% | 1.0% | 2.6% | 445.8 | 27,478 | 4,766 | 212,955 |
| Male unknown | 77.8% | 72.1% | 0.5% | 1.3% | 979.7 | 28,039 | 23,591 | 407,313 |
| All | 80.2% | 69.0% | 0.3% | 1.1% | 5,082.0 | 386,072 | 66,461 | 2,499,831 |
| All experience | | | | | | | | |
| Female non-smoker | 77.1% | 62.2% | 0.6% | 2.2% | 2,900.0 | 671,549 | 11,299 | 822,638 |
| Female smoker | 100.2% | 87.4% | 1.4% | 5.3% | 608.5 | 54,255 | 4,496 | 187,737 |
| Female unknown | 85.7% | 79.1% | 0.7% | 2.3% | 953.5 | 45,982 | 12,710 | 123,517 |
| Male non-smoker | 73.7% | 61.9% | 0.6% | 1.8% | 2,867.7 | 896,830 | 14,012 | 1,707,039 |
| Male smoker | 76.0% | 61.0% | 0.9% | 3.2% | 687.9 | 94,231 | 5,393 | 296,375 |
| Male unknown | 78.2% | 72.1% | 0.5% | 1.4% | 1,221.6 | 56,255 | 23,846 | 410,851 |
| All | 79.2% | 64.4% | 0.3% | 1.1% | 9,239.2 | 1,819,102 | 71,756 | 3,548,157 |

## 4.3 Distinguishing by preferred underwriting

Table 7 shows the experience for different classes of preferred, separately for males and females. The three classes presented are non-preferred (preferred rates were not available for this plan), residual (preferred rates were available, but the life insured did not qualify), and preferred (the life insured qualified for preferred rates).

Although the non-preferred class continues to dominate in the ultimate period, it is remarkable that the non-preferred class, measured by amount, has become the smallest class in the select period. The A/E ratios by amount are not as one would expect. Non-preferred has the lowest A/E ratios of the three classes in the select for females and highest for males. The difference between residual and preferred is not statistically significant for either male or female, select or ultimate. However, when reviewing the five-year results in the supplemental file referred to in Section 7.1, the preferred mortality is observed to be lower than non-preferred by count and amount, particularly for amounts of $100k–$2m.

| Table 7. Summary of experience, by sex and preferred class, policy year 2018–2019. Expected mortality on CIA9704 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Risk Class | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Select experience | | | | | | | | |
| Female non-pref | 75.8% | 47.9% | 2.1% | 8.9% | 778.3 | 144,312 | 1,143 | 96,718 |
| Female residual | 68.2% | 60.3% | 2.4% | 5.0% | 689.5 | 185,225 | 769 | 110,223 |
| Female preferred | 54.5% | 56.8% | 3.2% | 6.3% | 593.1 | 284,435 | 345 | 140,472 |
| Male non-pref | 78.2% | 58.7% | 1.8% | 8.4% | 734.9 | 164,627 | 1,450 | 184,644 |
| Male residual | 63.3% | 55.5% | 2.0% | 4.8% | 721.4 | 277,522 | 961 | 232,033 |
| Male preferred | 59.5% | 55.0% | 2.4% | 4.6% | 640.0 | 376,908 | 627 | 284,238 |
| All | 68.8% | 55.7% | 0.9% | 2.6% | 4,157.2 | 1,433,030 | 5,295 | 1,048,326 |
| Ultimate experience | | | | | | | | |
| Female non-pref | 85.6% | 74.0% | 0.5% | 1.8% | 2,247.3 | 133,645 | 25,717 | 724,008 |
| Female residual | 84.0% | 74.7% | 3.9% | 7.3% | 85.4 | 8,281 | 367 | 21,461 |
| Female preferred | 68.1% | 76.6% | 5.2% | 10.6% | 68.5 | 15,885 | 164 | 41,010 |
| Male non-pref | 77.2% | 67.1% | 0.4% | 1.3% | 2,526.2 | 193,122 | 39,592 | 1,606,404 |
| Male residual | 75.8% | 74.3% | 3.4% | 7.5% | 81.6 | 11,875 | 397 | 44,927 |
| Male preferred | 62.8% | 57.9% | 4.1% | 9.7% | 73.1 | 23,262 | 224 | 62,020 |
| All | 80.2% | 69.0% | 0.3% | 1.1% | 5,082.0 | 386,072 | 66,461 | 2,499,831 |
| All experience | | | | | | | | |
| Female non-pref | 85.2% | 69.5% | 0.5% | 2.1% | 3,025.6 | 277,958 | 26,860 | 820,726 |
| Female residual | 72.6% | 62.2% | 2.1% | 4.5% | 774.9 | 193,507 | 1,136 | 131,684 |
| Female preferred | 58.2% | 60.3% | 2.7% | 5.5% | 661.6 | 300,321 | 509 | 181,482 |
| Male non-pref | 77.2% | 66.1% | 0.3% | 1.5% | 3,261.1 | 357,749 | 41,042 | 1,791,048 |
| Male residual | 66.5% | 57.9% | 1.7% | 4.3% | 803.0 | 289,397 | 1,358 | 276,960 |
| Male preferred | 60.4% | 55.5% | 2.1% | 4.1% | 713.1 | 400,170 | 851 | 346,257 |
| All | 79.2% | 64.4% | 0.3% | 1.1% | 9,239.2 | 1,819,102 | 71,756 | 3,548,157 |

The difference between residual and preferred is startling. One would expect that the A/E ratios for preferred would be much lower than residual in the early policy years and gradually converging at higher durations. In fact there is very little difference, by amount, in the select period, and for males at least, the difference is wider in the ultimate.

One might wonder if the differences are clouded by differing distributions between preferred and residual with respect to size and age, but after adjusting for the differences in distribution, the same pattern is observed. When looking at the last five years of experience, one sees that preferred has consistently higher A/E than residual in the early policy years, gradually changing to lower A/E with increasing duration. The ultimate A/E ratios for preferred are about 75% of those for residual. Because less than 10% of the exposure for residual and preferred is in the ultimate, one should not be quick to draw conclusions.

This aspect of the mortality study warrants close attention in the future.

## 4.4 Distinguishing by size

Table 8 shows the experience for eight size bands for the face amount, separately for females and males. Note that each band is closed-open; that is, it begins with the specified amount and ends less than the second specified amount. The findings in this table are particularly significant. There is a very strong downward trend in A/E ratios with increasing size.

**Table 8. Summary of experience, by sex and size, policy year 2018–2019. Expected mortality on CIA9704**

| Size Band | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
|---|---|---|---|---|---|---|---|---|
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Female | | | | | | | | |
| 0–10k | 87.0% | 93.5% | 0.8% | 1.0% | 342.7 | 1,284 | 9,988 | 36,767 |
| 10–50k | 90.4% | 86.6% | 0.7% | 0.8% | 1,200.3 | 28,008 | 12,835 | 237,227 |
| 50–100k | 71.6% | 72.4% | 1.4% | 1.4% | 764.5 | 44,633 | 2,546 | 147,871 |
| 100–250k | 68.3% | 67.9% | 1.4% | 1.4% | 1,139.8 | 155,250 | 2,313 | 293,291 |
| 250–500k | 62.3% | 61.8% | 2.8% | 2.7% | 561.8 | 174,172 | 523 | 155,667 |
| 500k–1m | 61.8% | 61.4% | 4.2% | 4.2% | 339.3 | 195,847 | 223 | 127,087 |
| 1–2m | 50.6% | 49.5% | 7.3% | 7.3% | 94.7 | 105,669 | 60 | 66,547 |
| 2m+ | 43.0% | 46.2% | 12.6% | 18.0% | 18.8 | 66,922 | 17 | 69,435 |
| All | 83.9% | 67.0% | 0.5% | 1.9% | 4,462.0 | 771,785 | 28,505 | 1,133,892 |
| Male | | | | | | | | |
| 0–10k | 77.0% | 82.0% | 0.6% | 0.7% | 381.3 | 1,618 | 13,477 | 57,988 |
| 10–50k | 82.6% | 80.3% | 0.5% | 0.6% | 1,201.8 | 28,048 | 18,532 | 374,713 |
| 50–100k | 71.1% | 70.9% | 1.0% | 1.0% | 755.6 | 44,976 | 4,864 | 289,671 |
| 100–250k | 67.7% | 67.5% | 1.0% | 1.0% | 1,181.4 | 159,907 | 4,452 | 569,694 |
| 250–500k | 63.1% | 63.4% | 1.9% | 1.9% | 599.6 | 185,725 | 1,113 | 337,819 |
| 500k–1m | 57.0% | 56.8% | 2.6% | 2.6% | 424.6 | 245,853 | 526 | 300,744 |
| 1–2m | 52.2% | 52.8% | 3.9% | 3.9% | 180.3 | 201,448 | 213 | 241,976 |
| 2m+ | 53.9% | 48.1% | 6.6% | 9.1% | 52.7 | 179,742 | 75 | 241,660 |
| All | 76.4% | 63.3% | 0.3% | 1.4% | 4,777.2 | 1,047,317 | 43,251 | 2,414,265 |

## 4.5 Distinguishing by policy type

Table 9 shows the experience for various policy types (also known as plans of insurance or products), separately by sex. “First” refers to the first term of a renewable term plan, and “renewal” refers to all subsequent terms. One expects the A/E ratios to be much lower for “first” because it is newly underwritten and because one rarely accepts the rates for subsequent terms unless one cannot requalify for a new policy at the renewal.

| Table 9. Summary of experience, by sex and policy type, policy year 2018–2019. Expected mortality on CIA9704 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Policy Type | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Female | | | | | | | | |
| Whole Life | 86.7% | 69.0% | 0.6% | 3.1% | 1,978.3 | 146,419 | 20,176 | 370,648 |
| T10 first | 51.2% | 47.0% | 3.9% | 5.9% | 308.9 | 143,643 | 232 | 66,800 |
| T10 renewal | 101.0% | 112.6% | 5.0% | 6.5% | 87.8 | 20,456 | 277 | 54,713 |
| T20 first | 59.2% | 54.0% | 3.2% | 4.2% | 527.7 | 242,470 | 384 | 105,142 |
| T20 renewal | 106.5% | 139.0% | 20.1% | 23.0% | 4.7 | 696 | 18 | 3,047 |
| UL-YRT | 80.0% | 64.3% | 2.7% | 8.3% | 310.0 | 49,465 | 695 | 61,440 |
| UL-LCOI | 71.2% | 65.4% | 1.6% | 6.1% | 458.9 | 61,614 | 1,840 | 217,485 |
| UL-LP | 69.9% | 67.9% | 6.0% | 21.1% | 168.0 | 21,312 | 127 | 13,813 |
| T100 | 84.4% | 72.8% | 1.5% | 4.7% | 203.5 | 18,310 | 2,411 | 139,537 |
| OtherTerm(1st/unk) | 87.5% | 102.8% | 17.6% | 35.6% | 9.0 | 2,005 | 19 | 2,923 |
| Other renewal | 85.8% | 99.8% | 5.6% | 7.5% | 71.5 | 13,301 | 192 | 21,926 |
| Other | 83.1% | 74.0% | 1.6% | 3.9% | 333.8 | 52,094 | 2,134 | 76,418 |
| All | 83.9% | 67.0% | 0.5% | 1.9% | 4,462.0 | 771,785 | 28,505 | 1,133,892 |
| Male | | | | | | | | |
| Whole Life | 78.1% | 69.2% | 0.4% | 2.1% | 2,180.3 | 180,599 | 32,195 | 942,597 |
| T10 first | 56.9% | 51.1% | 2.5% | 4.9% | 409.6 | 253,123 | 539 | 216,186 |
| T10 renewal | 102.5% | 111.1% | 3.4% | 5.2% | 98.1 | 28,029 | 527 | 125,913 |
| T20 first | 60.5% | 60.9% | 2.4% | 3.8% | 565.3 | 310,386 | 645 | 252,635 |
| T20 renewal | 109.6% | 107.1% | 15.0% | 19.7% | 4.8 | 873 | 30 | 4,775 |
| UL-YRT | 76.2% | 63.7% | 2.1% | 7.6% | 311.0 | 58,429 | 1,043 | 131,679 |
| UL-LCOI | 64.2% | 44.0% | 1.4% | 4.4% | 449.7 | 89,119 | 2,019 | 254,088 |
| UL-LP | 60.5% | 68.3% | 5.5% | 15.7% | 139.0 | 18,983 | 124 | 18,166 |
| T100 | 74.7% | 67.0% | 1.3% | 4.0% | 185.2 | 25,307 | 2,733 | 282,413 |
| OtherTerm(1st/unk) | 50.0% | 46.4% | 13.4% | 31.0% | 10.0 | 2,759 | 17 | 2,811 |
| Other renewal | 87.6% | 89.8% | 3.9% | 6.3% | 79.2 | 16,213 | 352 | 47,822 |
| Other | 75.4% | 66.1% | 1.2% | 3.9% | 345.0 | 63,498 | 3,027 | 135,179 |
| All | 76.4% | 63.3% | 0.3% | 1.4% | 4,777.2 | 1,047,317 | 43,251 | 2,414,265 |

## 4.6 Distinguishing by province/region

Contributing companies were asked to provide information on province for the first time last year. At that time, the definition was province at time of issue, but few companies were able to provide that information reliably. This year the definition was changed to province of residence, and more companies were able to provide the information. It is expected that the information will be very nearly complete next year.

Table 10 shows experience by province (or region) of residence. It is of interest primarily for comparison to all of Canada. Only half of the companies were able to provide province codes;

Table 10 includes their data only. *Other* includes the territories and business that was issued as Canadian but the residence is now outside of Canada.[2] The four Atlantic provinces are combined into one region.

One should interpret this table with caution. The distribution by size and by plan could be quite different between provinces; the differences in A/E ratio may reflect that distribution more than a real difference in mortality.

**Table 10. Summary of experience by sex and province, policy year 2018–2019. Excluding companies that could not distinguish provinces. Expected mortality on CIA9704**

| Prov/Region | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
|---|---|---|---|---|---|---|---|---|
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Female | | | | | | | | |
| Atlantic | 96.2% | 75.3% | 2.9% | 11.0% | 98.6 | 12,582 | 773 | 22,348 |
| Quebec | 88.4% | 69.8% | 1.0% | 3.7% | 884.4 | 79,854 | 6,363 | 142,479 |
| Ontario | 84.2% | 68.6% | 1.2% | 3.9% | 649.1 | 124,111 | 3,796 | 162,847 |
| Manitoba | 81.9% | 63.6% | 5.6% | 11.8% | 44.8 | 9,776 | 176 | 9,985 |
| Saskatchewan | 84.2% | 76.7% | 6.2% | 17.8% | 36.8 | 8,995 | 152 | 12,195 |
| Alberta | 77.6% | 58.9% | 3.2% | 10.7% | 192.5 | 53,861 | 506 | 38,452 |
| British Columbia | 76.6% | 63.5% | 2.7% | 8.4% | 207.6 | 54,356 | 697 | 55,805 |
| *Provinces* | *86.2%* | *67.7%* | *0.7%* | *2.5%* | *2,113.7* | *343,534* | *12,463* | *444,111* |
| Other | 76.8% | 69.6% | 4.9% | 28.0% | 117.9 | 18,438 | 225 | 13,994 |
| *Total* | *86.0%* | *67.8%* | *0.7%* | *2.6%* | *2,231.6* | *361,972* | *12,688* | *458,105* |
| Male | | | | | | | | |
| Atlantic | 83.5% | 66.2% | 2.2% | 6.2% | 109.4 | 16,862 | 1,168 | 43,612 |
| Quebec | 79.7% | 64.7% | 0.9% | 3.4% | 841.5 | 100,756 | 7,100 | 257,974 |
| Ontario | 77.9% | 66.5% | 1.0% | 3.3% | 637.4 | 147,305 | 5,423 | 310,802 |
| Manitoba | 77.6% | 63.0% | 3.9% | 10.7% | 51.2 | 12,984 | 330 | 22,024 |
| Saskatchewan | 84.3% | 72.3% | 4.0% | 12.2% | 42.9 | 11,929 | 344 | 21,975 |
| Alberta | 71.8% | 60.1% | 2.2% | 7.7% | 202.1 | 67,953 | 935 | 86,816 |
| British Columbia | 69.6% | 61.4% | 1.9% | 5.7% | 215.9 | 64,465 | 1,268 | 111,415 |
| *Provinces* | *78.1%* | *64.6%* | *0.6%* | *2.0%* | *2,100.4* | *422,255* | *16,568* | *854,617* |
| Other | 61.0% | 48.7% | 3.3% | 21.7% | 133.7 | 27,729 | 374 | 25,657 |
| *Total* | *77.6%* | *64.0%* | *0.5%* | *2.1%* | *2,234.1* | *449,984* | *16,942* | *880,275* |

## 4.7 Distinguishing by cause of death

Cause of death has returned to our mortality study. (It was excluded from the data specifications for 2014–2018.) Cause of death is particularly important for COVID-19. There are no deaths by that cause in this study, but it will be of interest in future studies.

Table 11 shows the causes of death identified in this study. The number and amount of death claims (in thousands) are shown in the second and third columns. The fourth and fifth columns

[2] There were only 20 deaths for the territories, and as such it is not reasonable to distinguish them in the table.

show the distribution of the number of deaths and amount of death claims over those for which the cause of death is identified (neither *No code* nor *Other/unknown*) in the study. "No code" means that no cause of death was provided on the death record; three of the eight companies did not give cause-of-death codes, and a small number of records for the other companies left the cause of death blank. Most cases in *Other/unknown* are ones for which the company indicated that it did not know the cause; there are also some for which the company indicated a cause of death not otherwise covered by the 14 codes used by the CIA.

**Table 11. Analysis by cause of death for policy year 2018–2019**

| Cause of death | Number of deaths | Death Claims k$ | Ratio to number identified | Ratio to amount identified |
|---|---|---|---|---|
| Malignant neoplasms | 12,360 | 752,043 | 48.1% | 51.3% |
| Diseases of heart | 5,486 | 277,115 | 21.4% | 18.9% |
| Accidents | 970 | 87,311 | 3.8% | 6.0% |
| Cerebrovascular | 1,640 | 77,889 | 6.4% | 5.3% |
| Influenza and pneumonia | 1,896 | 68,434 | 7.4% | 4.7% |
| Intentional self-harm | 473 | 67,727 | 1.8% | 4.6% |
| Alzheimer's | 1,152 | 56,099 | 4.5% | 3.8% |
| Chronic lower respiratory | 964 | 36,485 | 3.8% | 2.5% |
| Liver disease and cirrhosis | 260 | 18,395 | 1.0% | 1.3% |
| Nephritis, etc | 279 | 14,591 | 1.1% | 1.0% |
| Assault | 34 | 6,191 | 0.1% | 0.4% |
| Diabetes mellitus | 159 | 3,804 | 0.6% | 0.3% |
| Other/unknown | 18,359 | 732,983 | 71.5% | 50.0% |
| No code | 27,724 | 1,349,090 | 108.0% | 92.0% |
| Total | 71,756 | 3,548,157 | 279.5% | 242.0% |

## 4.8 Distinguishing by rating

This year the study began to accept substandard policies for which the mortality rating was a multiple of standard, but not those with flat extras. Previously companies were asked not to submit records for substandard[3] policies. All companies but one were able to submit substandard policies. These substandard policies are excluded from all the data presented in this study except in this section. Table 12 compares the experience for standard policies with that for substandard. The expected is on CIA9704 in both cases, with no adjustment for the rating. The data submitted indicate whether a policy is substandard, but the rating assigned in the underwriting process is not provided.

It is obvious (and expected) that there is much less substandard experience than standard, and accordingly standard deviations are much higher for substandard. The summaries do not distinguish by smoking status because the standard deviations for substandard are so large, particularly for smokers and unknown, that no inferences can be drawn.

[3] Some age-rated policies may be included with standard because they cannot be identified as substandard.

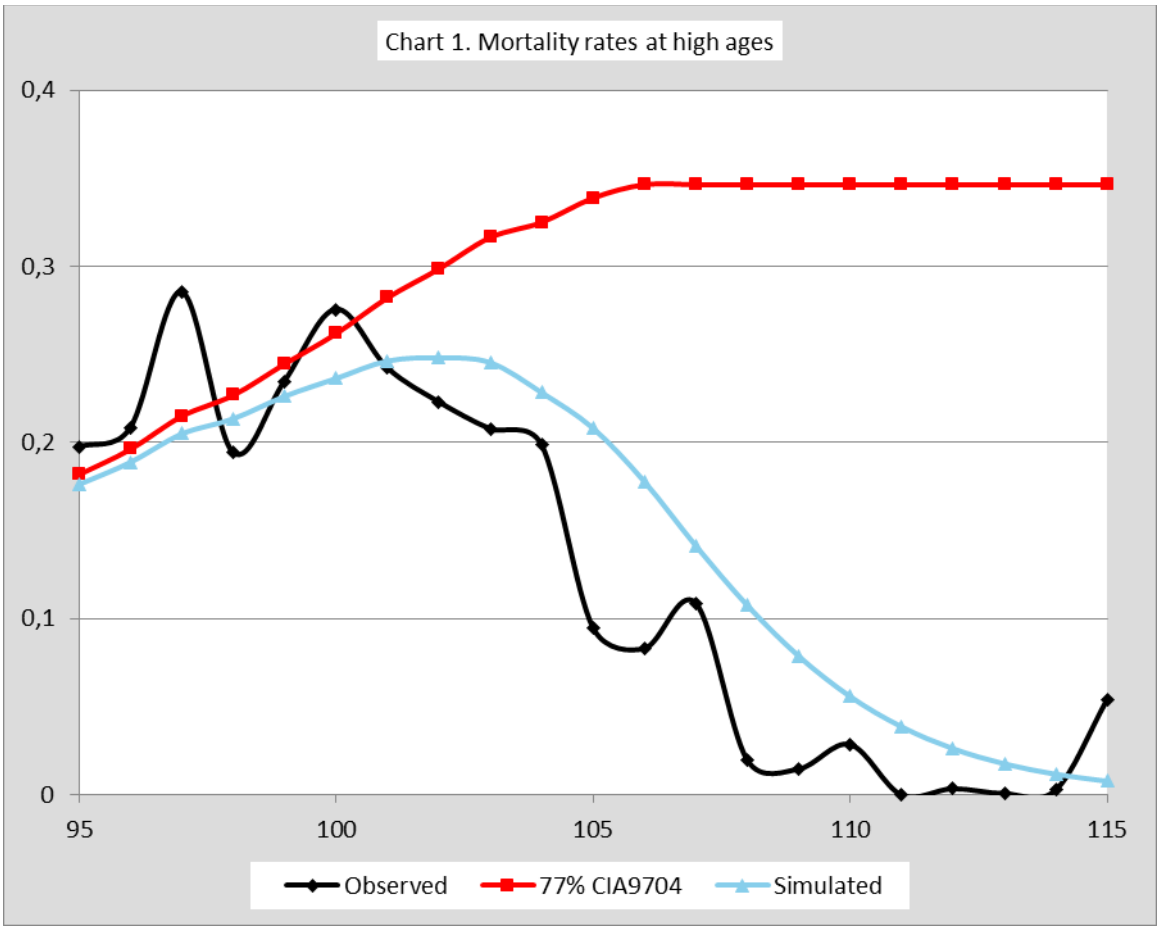
| Table 12. Summary of experience by rating, policy year 2018–2019. Expected mortality on CIA9704 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| All | | | | | | | | |
| Standard | 79.2% | 64.4% | 0.3% | 1.1% | 9,239.2 | 1,819,102 | 71,756 | 3,548,157 |
| Substandard | 122.1% | 98.6% | 1.8% | 10.2% | 318.5 | 97,787 | 3,565 | 253,649 |
| Female select | | | | | | | | |
| Standard | 69.1% | 55.0% | 1.4% | 4.0% | 2,060.9 | 613,973 | 2,257 | 347,412 |
| Substandard | 98.9% | 111.3% | 6.0% | 22.5% | 111.2 | 32,732 | 309 | 59,839 |
| Male select | | | | | | | | |
| Standard | 68.6% | 56.1% | 1.2% | 3.3% | 2,096.3 | 819,057 | 3,038 | 700,914 |
| Substandard | 104.2% | 91.0% | 4.7% | 15.2% | 132.2 | 59,681 | 428 | 115,181 |
| Female ultimate | | | | | | | | |
| Standard | 85.5% | 74.1% | 0.5% | 1.8% | 2,401.1 | 157,812 | 26,248 | 786,480 |
| Substandard | 134.8% | 117.3% | 3.0% | 11.1% | 41.6 | 2,109 | 1,653 | 31,802 |
| Male ultimate | | | | | | | | |
| Standard | 77.1% | 66.8% | 0.3% | 1.3% | 2,680.9 | 228,260 | 40,213 | 1,713,351 |
| Substandard | 121.3% | 93.9% | 3.0% | 25.7% | 33.5 | 3,264 | 1,175 | 46,828 |

## 4.9 Oldest ages

As mentioned earlier, this study excludes attained ages over 100. This section explains why. Further detail on the data at attained ages over 100 is included in Appendix 2, but it is strongly cautioned that the **data over age 100 not be used for any actuarial assumptions** because it cannot be considered reliable.

Chart 1 shows observed ultimate mortality rates for policy years 2014–2019 compared to the corresponding expected on 77%[4] of CIA9704. There is a third line, called “Simulated”, which is described below.

[4] The A/E ratio for ages 90–95 in the ultimate is 77% on CIA9704.




To understand how the discrepancy between observed and expected can be so large, consider a hypothetical example in which actual mortality follows 77% of the table. (The Simulated line in Chart 1 is calculated from this example.) Consider lives insured at age 85. Of them, 99% are assumed to be careful with their life insurance policies; they are in touch with their insurance advisor, their policies are kept in a safe place where they will be readily found, or their beneficiaries have complete information on the policies, and consequently their deaths will be reported in a timely manner. But 1% are careless; the insurance policy is lost and forgotten and the beneficiary is unaware that a claim could be made on death. The careless ones will die (as estimated by the table) but the insurance company will never know. The impact on the apparent mortality rate is initially small, but it becomes huge. By age 95, the "careless" represent about 3% of the policies thought to be still in force; by age 100, 10%; by age 105, 39%; and by age 115, 98%.

Note how close the Simulated line is to the Observed. That does not prove that the insurance companies have lost contact with many older lives insured who have already died, but it shows the hypothesis to be reasonable.[5] Experience over age 100 cannot be considered sufficiently reliable for actuarial purposes.

[5] There may be other explanations for some of these policies. If the problem is a lack of information, it will not be feasible to study the matter further.

# 5 Experience for Last Five (or 10) Years

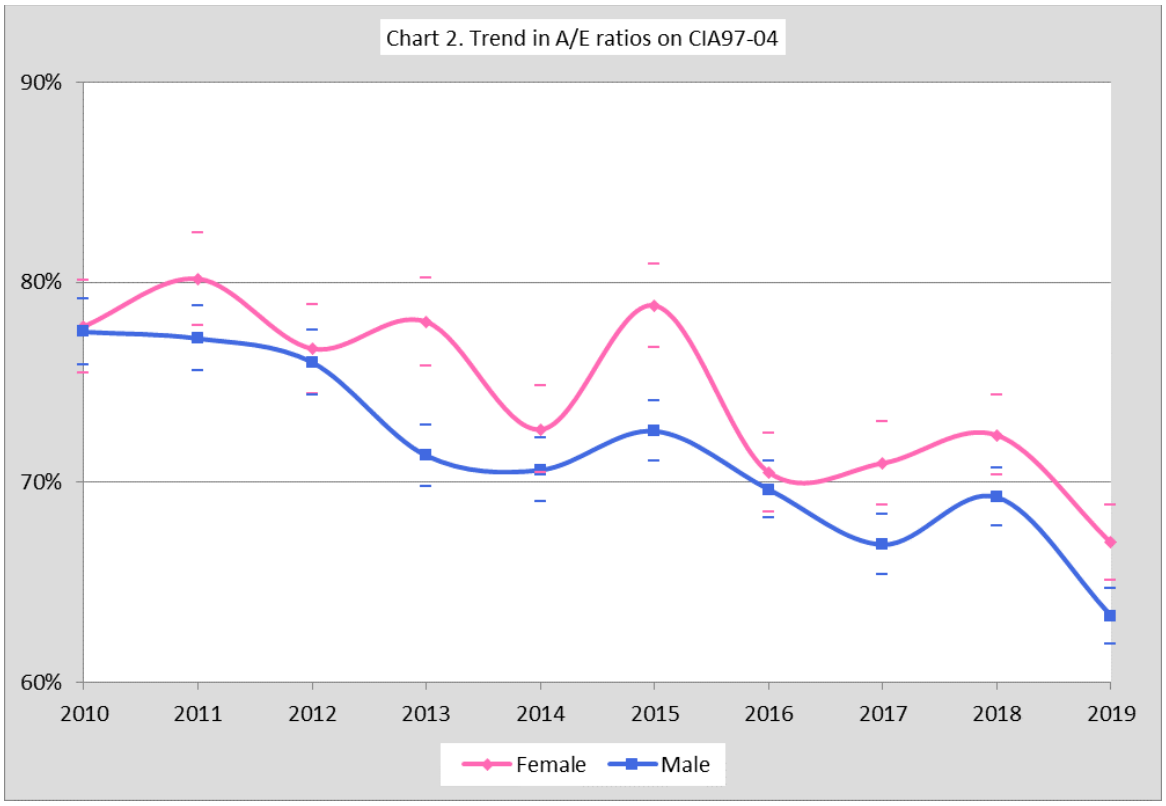
Although it is important to observe the experience of each year closely, one cannot get the full picture of mortality within the Canadian life insurance industry from one year alone. It is better to examine at least five years. Over that time the effect of statistical fluctuation will be of less concern and the trend in mortality may emerge. Detailed tables are included in the Excel workbook associated with this report, available on the CIA website. Some summary information follows.

Table 13 shows the A/E ratios for each of the last five years and for the five years combined.

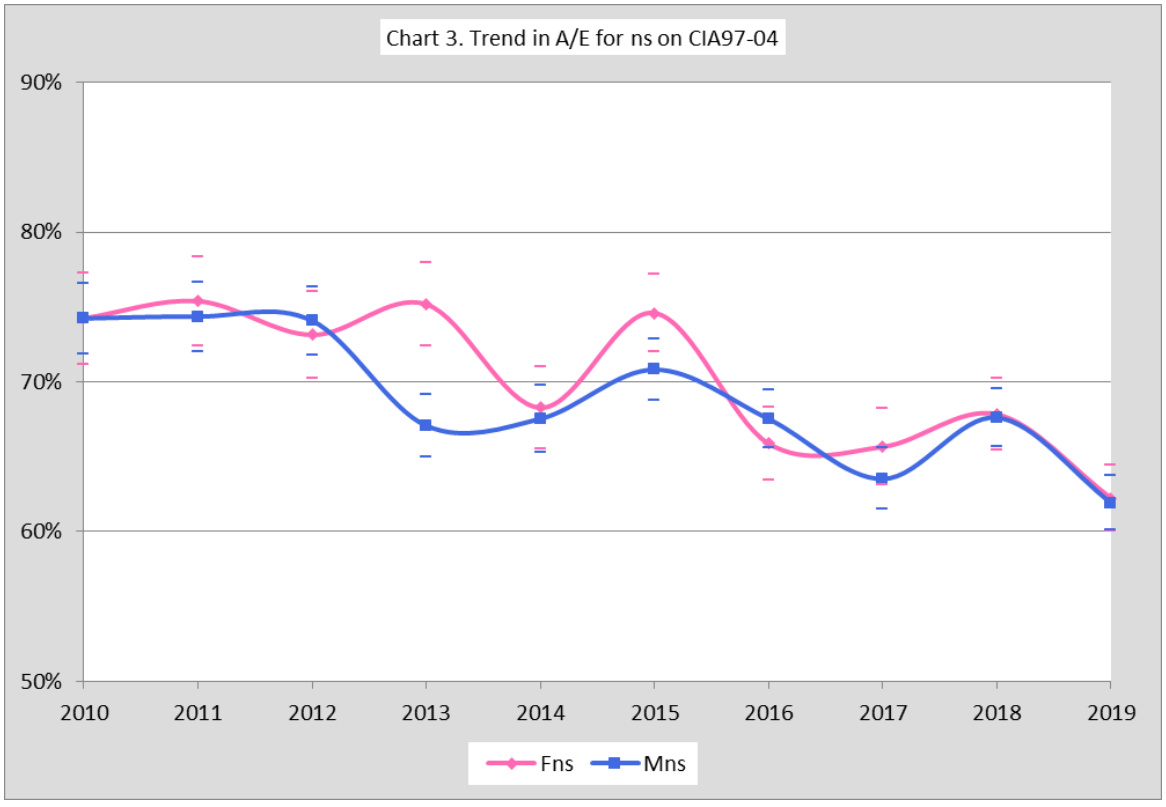
**Table 13. Summary of experience by sex, policy years 2014–2019. Expected mortality on CIA9704**

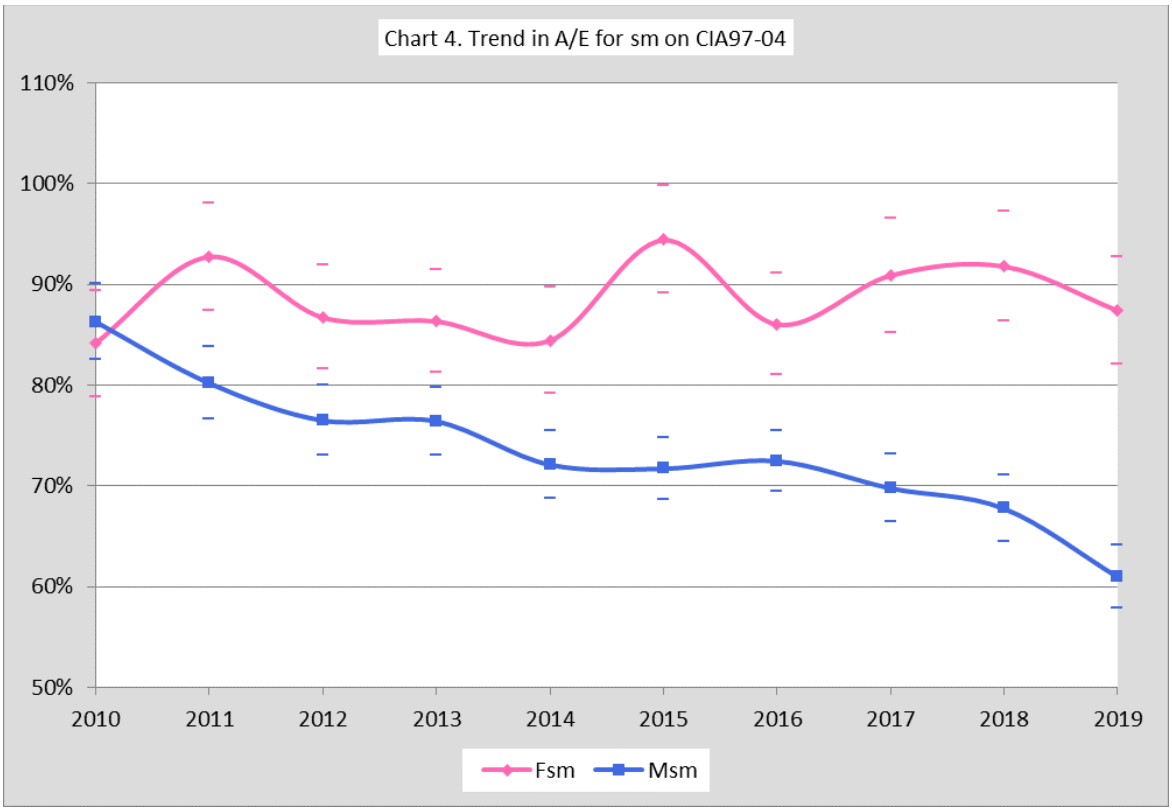
| Policy Year | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
|---|---|---|---|---|---|---|---|---|
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Female | | | | | | | | |
| 2014–2015 | 90.9% | 78.8% | 0.5% | 2.1% | 4,095.3 | 614,442 | 26,779 | 952,816 |
| 2015–2016 | 85.2% | 70.5% | 0.5% | 2.0% | 4,299.4 | 646,807 | 26,152 | 926,005 |
| 2016–2017 | 86.5% | 71.0% | 0.5% | 2.1% | 4,070.2 | 623,235 | 26,690 | 950,832 |
| 2017–2018 | 87.1% | 72.3% | 0.5% | 2.0% | 4,359.6 | 729,158 | 28,508 | 1,131,830 |
| 2018–2019 | 83.9% | 67.0% | 0.5% | 1.9% | 4,462.0 | 771,785 | 28,505 | 1,133,892 |
| 2014–2019 | 86.6% | 71.6% | 0.2% | 0.9% | 21,286.4 | 3,385,427 | 136,633 | 5,095,376 |
| Male | | | | | | | | |
| 2014–2015 | 82.5% | 72.6% | 0.4% | 1.5% | 4,537.0 | 884,079 | 42,657 | 2,115,821 |
| 2015–2016 | 79.5% | 69.6% | 0.4% | 1.4% | 4,727.7 | 918,423 | 42,306 | 2,169,528 |
| 2016–2017 | 79.0% | 66.9% | 0.4% | 1.5% | 4,427.6 | 870,690 | 41,366 | 2,029,742 |
| 2017–2018 | 79.6% | 69.3% | 0.4% | 1.5% | 4,699.3 | 1,001,326 | 43,721 | 2,440,769 |
| 2018–2019 | 76.4% | 63.3% | 0.3% | 1.4% | 4,777.2 | 1,047,317 | 43,251 | 2,414,265 |
| 2014–2019 | 79.4% | 68.1% | 0.2% | 0.7% | 23,168.9 | 4,721,835 | 213,300 | 11,170,125 |

Chart 2 shows the A/E ratio for each of the last 10 years for females (in pink) and males (in blue). There are pink and blue tick marks above and below the A/E lines. These represent one standard deviation above and below the mean.




Charts 3 and 4 show the same information but separately for non-smokers and smokers. Except for female smokers, the A/E ratios in 2018–2019 are the lowest they have ever been.






The trend for female smokers is markedly different from that of the others shown. There is no evident mortality improvement over the last 10 years for female smokers. Consequently the gaps in experience between male and female smokers and between female non-smokers and female smokers are widening. This widening is an important finding, although not a new one. It was observed before but not highlighted.

Because the correlation between size and mortality is so significant, it is good to look at the A/E ratios over a five-year period, to lessen the effect of fluctuation. Table 14 shows the ratios separately for females and males. (Recall that size bands are closed-open intervals.)

| Table 14. Summary of experience, by sex and size, policy years 2014–2019. Expected mortality on CIA9704 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Size Band | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Female | | | | | | | | |
| 0–10k | 89.6% | 96.1% | 0.4% | 0.4% | 1,910.5 | 7,149 | 53,326 | 194,594 |
| 10–50k | 91.4% | 88.0% | 0.3% | 0.4% | 6,051.9 | 139,277 | 57,811 | 1,063,355 |
| 50–100k | 76.4% | 76.8% | 0.7% | 0.7% | 3,659.9 | 213,969 | 11,604 | 673,074 |
| 100–250k | 72.4% | 72.6% | 0.7% | 0.7% | 5,360.9 | 732,909 | 10,381 | 1,337,469 |
| 250–500k | 65.0% | 65.3% | 1.4% | 1.4% | 2,464.4 | 775,817 | 2,216 | 678,954 |
| 500k–1m | 65.6% | 67.1% | 2.2% | 2.2% | 1,392.3 | 827,106 | 934 | 556,948 |
| 1–2m | 60.5% | 59.2% | 3.8% | 3.8% | 373.2 | 429,049 | 281 | 314,949 |
| 2m+ | 52.1% | 47.0% | 6.6% | 9.2% | 73.4 | 260,151 | 81 | 276,033 |
| All | 86.6% | 71.6% | 0.2% | 0.9% | 21,286.4 | 3,385,427 | 136,633 | 5,095,376 |
| Male | | | | | | | | |
| 0–10k | 80.5% | 85.7% | 0.3% | 0.3% | 2,151.3 | 9,155 | 73,278 | 314,254 |
| 10–50k | 84.6% | 82.8% | 0.3% | 0.3% | 6,197.9 | 142,565 | 89,512 | 1,801,065 |
| 50–100k | 73.7% | 73.6% | 0.5% | 0.5% | 3,649.9 | 218,028 | 22,180 | 1,328,104 |
| 100–250k | 69.9% | 70.0% | 0.5% | 0.5% | 5,651.0 | 768,254 | 19,841 | 2,569,678 |
| 250–500k | 64.3% | 65.2% | 0.9% | 0.9% | 2,712.4 | 852,942 | 4,771 | 1,482,474 |
| 500k–1m | 63.1% | 63.3% | 1.3% | 1.3% | 1,827.0 | 1,090,482 | 2,409 | 1,413,174 |
| 1–2m | 59.1% | 59.8% | 2.0% | 2.0% | 759.0 | 877,750 | 980 | 1,136,430 |
| 2m+ | 59.4% | 56.8% | 3.4% | 4.6% | 220.3 | 762,659 | 330 | 1,124,945 |
| All | 79.4% | 68.1% | 0.2% | 0.7% | 23,168.9 | 4,721,835 | 213,300 | 11,170,125 |

Chart 5 shows the A/E ratios by amount, the same information as in Table 14. The graphical display shows how strongly size and mortality are related, particularly for males. Note that the tick marks for one standard deviation above and below the observed mean are not evident for the first two bands because the numbers are so close together.

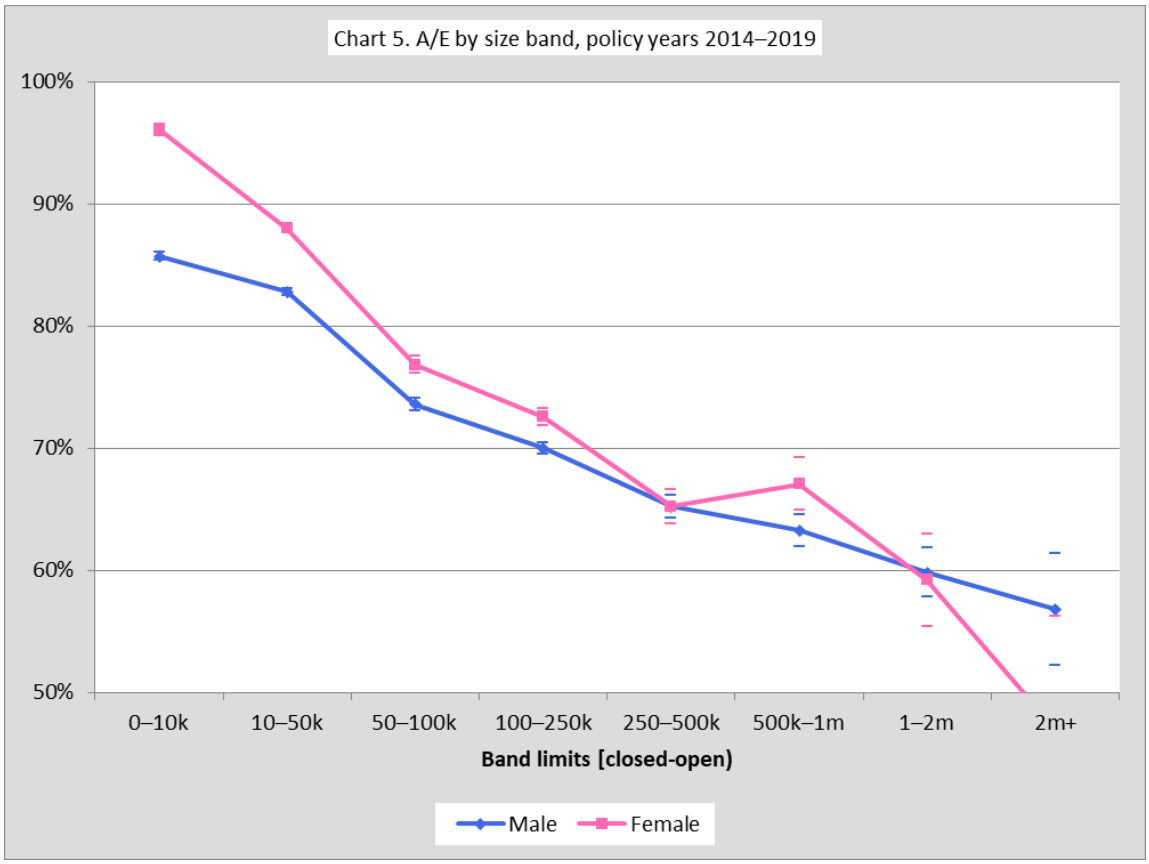


Chart 5. A/E by size band, policy years 2014–2019
100%
90%
80%
70%
60%
50%
0–10k
10–50k
50–100k
100–250k
250–500k
500k–1m
1–2m
2m+
Band limits [closed-open)
Male
Female

# 6 Significant Observations

The more significant observations for the study are:

1. Neither CIA9704 nor CIA8692 fit the experience well. The experience for female smokers is particularly out of step with other classes. It is time for a new table. (As mentioned above, the ERC has an active project to construct a new table.)
2. The downward trend in mortality appears to be continuing, except for female smokers. The uptick last year has not continued.
3. The A/E ratios decrease strongly with increasing size of face amount. Size and mortality are strongly correlated. Size is probably the most significant factor not currently reflected in standard mortality tables.
4. The A/E ratios for preferred and residual are much closer together than one might have expected, and this warrants further study.
5. This continuing study provides a valuable, consistent, and accurate observation of a substantial block of policies, covering a significant proportion of the Canadian population.

# 7 For Further Study

## 7.1 Additional tables available

More detailed tables for the last five years (not for the current year only) are available in an Excel workbook on the CIA website. The format of all tables is the same as shown above for Tables 3, 4, and 5. There is a worksheet, Index, which list all the tables available and provides a hyperlink to each one.

## 7.2 Database for independent study

The format for the database has changed this year, and there is a file for each of the current year and the prior[6] nine years. The database contains expected fields on CIA9704. The database is in comma-separated-value format. There is an Excel workbook which may be used to change the table for expected to any table desired by the member. Both CIA9704 and CIA8692 are supplied in the workbook. The member may use one of these tables, apply a multiple to them, or add a worksheet for a completely different table.

There is a zipped archive available on the CIA website containing the database and a text file for each of the 10 years. Each text file has a detailed description of the database and its codes. The archive also contains the workbook referred to above. There is a second archive available on the CIA website which contains the database for the last five years combined and the associated text file.

It is recommended that the new databases be used in place of the old because the new databases use the best information now available and because the algorithms are applied consistently across all years.

**The following was added to the document in December 2021, subsequent to publication of the original document.*

The databases originally published have been withdrawn and replaced for several reasons.

- It was requested to include an indication of base or rider in the database. The POG agreed to make this enhancement.
- Some found the "InitialTerm" field to be confusing. It has been redefined.
- A significant data error was discovered for five policy years ending in 2016 involving many misclassifications between base and rider. That error has been corrected. There were no errors in amount; only policy counts were incorrect. However, a study of experience between base and rider using databases published in earlier years may show

[6] The totals from the new databases do not match exactly the totals of the old databases. Most years are close in the amount fields. Counts are consistently higher in the new databases. The amount exposed in the new database for 2013–14 is about 2% lower than for the old, and the actual and expected deaths are 4% lower. It is likely that the difference resulted from the handling of conversions; 2013–14 was the year in which codes for converted policies were added to the input records. The information currently available to the researcher does not allow for a reconciliation of the difference. However, it is clear that the new databases were constructed on a consistent manner across all 10 years.

a larger differential in experience than we now know to be justified. Accordingly, use of those old databases is discouraged.

- The databases published earlier this year incorrectly:
    - put all Renewable Term under the T20 policy type in the 2009-2010 and 2010-2011 databases
    - classified OtherTerm vs. Other policy types in the 2011-2012 and later databases

  These have both been corrected.
- The work on the 2019–2020 policy year has found a few cases of incorrectly reported deaths. These have been corrected and are immaterial.

Because the aggregate effect of the changes referred to above is small, none of the tables in the report are being changed. However, a revised version of Table 13 is shown below for comparison. The aggregate A/E ratios by amount changed mostly by less than 0.05%. The aggregate change in A/E by count can be as much as 0.3% for 2014–2015 and 2015–2016.

The Revised Table 13 below gives an overall summary of the experience for the last five policy years after the above changes were made which can be compared to the original Table 13 in the report above.

**Revised Table 13. Summary of experience by sex, policy years 2014–2019. Expected mortality on CIA9704.**

| Policy Year | Act/Exp | | Std Dev | | Exposure | | Actual Deaths | |
|---|---|---|---|---|---|---|---|---|
| | Pols | Amt | Pols | Amt | Pols k | Amt m$ | Pols | Amt k$ |
| Female | | | | | | | | |
| 2014–2015 | 90.7% | 78.8% | 0.5% | 2.1% | 4,313.4 | 614,442 | 26,942 | 952,816 |
| 2015–2016 | 85.4% | 70.5% | 0.5% | 2.0% | 4,307.4 | 646,807 | 26,237 | 926,005 |
| 2016–2017 | 86.5% | 71.0% | 0.5% | 2.1% | 4,070.2 | 623,235 | 26,690 | 950,832 |
| 2017–2018 | 87.1% | 72.3% | 0.5% | 2.0% | 4,359.6 | 729,158 | 28,508 | 1,131,830 |
| 2018–2019 | 83.9% | 67.1% | 0.5% | 1.9% | 4,462.0 | 771,786 | 28,506 | 1,135,128 |
| 2014–2019 | 86.7% | 71.6% | 0.2% | 0.9% | 21,512.5 | 3,385,428 | 136,882 | 5,096,612 |
| Male | | | | | | | | |
| 2014–2015 | 82.4% | 72.6% | 0.4% | 1.5% | 4,774.8 | 884,079 | 42,938 | 2,115,821 |
| 2015–2016 | 79.7% | 69.6% | 0.4% | 1.4% | 4,731.3 | 918,423 | 42,454 | 2,169,528 |
| 2016–2017 | 79.0% | 66.9% | 0.4% | 1.5% | 4,427.6 | 870,690 | 41,366 | 2,029,742 |
| 2017–2018 | 79.6% | 69.3% | 0.4% | 1.5% | 4,699.3 | 1,001,326 | 43,721 | 2,440,769 |
| 2018–2019 | 76.4% | 63.3% | 0.3% | 1.4% | 4,777.2 | 1,047,317 | 43,245 | 2,414,588 |
| 2014–2019 | 79.4% | 68.1% | 0.2% | 0.7% | 23,410.3 | 4,721,835 | 213,723 | 11,170,448 |

# 8 Credits

This report was prepared by R.C.W. (Bob) Howard and approved by the CIA Research Council, the ERC, and the Project Oversight Group:

Keith Walter (Research Council Chair)

Nicolas Genois (Experience Research Committee Chair)

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Simon Martel

Marie-Claude Rioux

Joel Smith

Rita Wu

# Appendix 1 Details of Data and Method

## 1.1 History of changes

### 1.1.1 2018–2019

1. Cause of death is requested for all death records.
2. Substandard business may be included if separately identified and the rating is a multiple of the standard class. Business with flat extras is still excluded.
3. Province code is to refer to current residence.
4. Guaranteed issue business may be included and separately identified.
5. Policies are counted after combining records with the same policy number and other identifying fields. Previously one policy was counted for each unique combination of policy number, sex, date of birth, and policy type. In both cases, riders were ignored for policy count.
6. The size band was determined by totalling the amounts for all records with the same policy number, date of issue, and date of birth. Previously the size band was determined for each record independently.

### 1.1.2 2017–2018

1. Province code was requested, based on province of residence at issue.
2. Codes were added to indicate whether blood, urine, or saliva were used in the underwriting process.

### 1.1.3 2013–2014

1. Codes to indicate the type of conversion and the date of conversion were added. In 2013–2014 and 2014–2015 conversions with issue date equal to conversion date were excluded. Subsequently all conversions were excluded.
2. Simplified issue business may be included and separately identified.
3. Not all companies were able to provide the data requested in the first year of the request.

The experience of prior years was restated to be consistent with the current method. The A/E ratios in prior reports are generally very slightly higher than shown in Table 1, but rarely more than 0.3% higher.

## 1.2 Policies and amounts

Policies can be counted only approximately. Records identified as riders have no policy count associated with them. Some companies submit multiple records for a policy. An attempt is made to count each policy only once, but the process is not perfect. The current algorithm counts as one policy a group of records having all the same identifying fields (excluding amounts). For example, if there are two distinct issue dates for the same life and the same policy number, these would be counted as two policies. In the past they would likely have been

counted as one. The same algorithm applies to both exposure and deaths. Amounts are not affected by the change in algorithm.

"Amount" refers to the face amount of the policy or rider in the case of exposure and deaths. Some mortality studies have attempted to show the actual death benefit paid, which could be less than the face amount for a disputed claim. Although the data instructions (see Appendix 3) permit the death claim amount to be reported as less than the face amount, that distinction is not used in this study because few companies are able to make a distinction. The impact is very small except for the first two policy years, for which it is minor.

## 1.3 Policy year and duration

By tradition, policy years are referred to as ordinals: *first*, *second*, *third*, …, relative to the issue date or collectively as the calendar years in which the policy year starts and ends, as in 2018–2019. Durations are referred to as the exact number of years since issue, or as cardinals: *0*, *1*, *2*, …, referring to entire years beginning at issue or on anniversaries of issue. Both terms are used in this report, although policy year is more common.

A policy year is taken as starting on a policy anniversary and ending just before the next anniversary. One might call this an "on-before" definition. This definition is consistent with how durations are defined, how annual premiums are billed, and how we typically refer to our own age (we go to the next number on our birthday).

However, some companies submit data on the basis of an "after-on" definition; that is, the policy year begins after an anniversary and ends exactly on the next anniversary. That is significant for the study because some deaths would be submitted on the first day of the next policy year (by the standard definition). The record is accepted nonetheless. It is counted as in-force for the entire current duration, and a death is recorded for the next duration, with all being reported in the policy year under study.

Note that the issue date is specified on the records provided by the contributing companies. But that date is not always, strictly speaking, the issue date of the policy; it could be a later effective date for the coverage described by the record. For example, if a term rider were added subsequently to the issue of the policy, the "issue" date on the record would be the date that the new rider becomes effective; it would not necessarily be a policy anniversary.

Deaths reported too late to be included in one study are submitted in the next study. They are counted as deaths at the appropriate duration, but there is no exposure in the current duration, because the life died earlier.

## 1.4 Age nearest and last birthday

Age nearest birthday is used throughout this report. If the record indicates that age last birthday was used, age nearest birthday is calculated from the date of birth and the date of issue. If the record indicates age last birthday and the date of birth is not given, then the stated age at issue is used, and half of the exposure and deaths are assigned to the stated age, and the other half assigned to the next age. The policy year is calculated from the date of issue, and is the same regardless of the calculation of issue age.

## 1.5 Exposure and expected

Exposure is calculated using the Balducci hypothesis, as is traditional for mortality studies of the CIA. Therefore, exposure on deaths continues to the next anniversary. Exposure on non-death terminations stops at the date of termination. That is, exposure is calculated as the number of days plus one from the anniversary on or last before termination to the date of termination, divided by 365. (February 29 is ignored in this calculation.)

Expected mortality is calculated in all cases on CIA9704.[7] In many cases it is also shown on CIA8692.[8] Both mortality tables are extended so that there are reasonable mortality rates for all issue ages and durations not exceeding attained age 100.

The smoking types for the published tables are “smoker”, “non-smoker”, and “combined”. Those types are used for experience with smoking classified as “smoker”, “non-smoker”, and “unknown”, respectively. In this study, smoking classifications are always kept distinct for calculating expected deaths and claims. When the smoking classifications are combined, the previously calculated expected deaths and claims are summed; the “combined” mortality rates are not applied to the aggregate exposure.

## 1.6 Standard Deviations

Several tables in this report show standard deviations in the A/E ratios. When comparing two ratios, it is important to note the standard deviation for each to determine if the difference between the ratios is significant. Generally we expect that the true mean lies within one standard deviation of the observed mean about two-thirds of the time.

These standard deviations 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-smoke-age-duration is binomially distributed, and that the mean of the distribution is given by a multiple of the mortality table used for expected deaths. The formula for standard deviation is shown below, by face amount, where $A_i$ is the face amount, $n_i$ is the number of policies exposed with that face amount and that sex-smoke-age-duration, $q_i$ is the mortality rate for that cell, and $m$ is the ratio of actual to expected claim amounts separately for each sex-smoke over all ages and durations, not for each cell or a

[7] CIA9704 was published to issue age 80 in CIA publication 210028. The table has an unofficial extension to issue age 85. It has been further extended to issue age 105. Select rates for issue age 105 were taken as 20% of the corresponding ultimate rate at duration 0, increasing by 10% each duration to 100% for durations 10–14. Rates for issue ages 86–104 were calculated by fitting an exponential to the rates for ages 85 and 105 for each duration. The minimum issue age published was 16 for smokers and non-smokers. The table is extended for all issue ages and durations using the rates for combined. Rates over attained age 100 are not used. Rates for smokers and non-smokers under attained age 16 are not used.

[8] CIA8692 was published to issue age 80 in CIA publication 9529 and extended to issue age 90 by CIA publication 215081. It has been further extended to issue age 105. Ultimate mortality rates were extended as 0.75 for ages 105–119. Select rates for issue age 105 were taken as 20% of the corresponding ultimate rate at duration 0, increasing by 10% each duration to 100% for durations 10–14. Rates for issue ages 91–104 were calculated by fitting an exponential to the rates for ages 90 and 105 for each duration. The minimum issue age published was 16 for smokers and non-smokers. The table is extended for all issue ages and durations using the rates for combined. Rates over attained age 100 are not used. Rates for smokers and non-smokers under attained age 16 are not used.

subset of the whole. The sum is over all records under consideration. The same formula may be used by count except that $A_i$ is 1 in all cases.

Standard deviation of A/E by amount = $$\frac{\left(\sum_i A_i^2 n_i (1 - mq_i) mq_i\right)^{0.5}}{\sum_i A_i n_i q_i}$$

The factor, *m*, ensures that the standard deviation is reasonable even though the mortality table used for expected deaths differs substantially from the actual.

## 1.7 Size bands

It has been observed for many years that the A/E ratio tends to decrease with increasing policy size. The tendency is both strong and persistent in the annual study of life insurance mortality. It is generally believed that the determining factor is socio-economic status, for which the amount of insurance on a life is a proxy. (More stringent underwriting at higher amounts may be a factor as well.) Therefore, it is preferable to determine the size of a policy not by the individual elements in a policy, but by the total amount of insurance in the policy. In the past the size banding was set at the record level. In this report, records with the same policy number, date of issue, and date of birth are combined for the purpose of determining which size band is appropriate for each record. For example, if a policy consisted of $75,000 of whole life insurance with a $200,000 term rider, both records would be assigned to the size band $250,000–499,999, although neither record is in that band by itself.

The change referred to in this section and the combining of records described in Section 1.2 of this appendix results in a small change in the distribution of exposure and of deaths. Table 15 shows the distribution of exposure into the eight size bands by the "new" method used in this report and the "old" method, which was used in the last several reports. The table also shows the A/E ratios. The change was significant for one contributing company that often had many records for one policy, but overall the impact of the change was small. The new method is more in line with the way banding is typically viewed in underwriting.

**Table 15. Comparing the impact of old and new banding method. All numbers are by amount**

| | Female | | | | Male | | | |
|---|---|---|---|---|---|---|---|---|
| | Proportion | | Act / Exp | | Proportion | | Act / Exp | |
| | New | Old | New | Old | New | Old | New | Old |
| 0–10k | 0.2% | 0.3% | 93.5% | 92.9% | 0.2% | 0.3% | 82.0% | 82.4% |
| 10–50k | 3.6% | 4.6% | 86.6% | 83.9% | 2.7% | 3.6% | 80.3% | 78.8% |
| 50–100k | 5.8% | 5.8% | 72.4% | 72.8% | 4.3% | 4.3% | 70.9% | 69.3% |
| 100–250k | 20.1% | 20.7% | 67.9% | 67.7% | 15.3% | 15.7% | 67.5% | 67.2% |
| 250–500k | 22.6% | 22.3% | 61.8% | 61.2% | 17.7% | 17.7% | 63.4% | 62.7% |
| 500k–1m | 25.4% | 24.8% | 61.4% | 60.4% | 23.5% | 23.2% | 56.8% | 57.1% |
| 1–2m | 13.7% | 13.3% | 49.5% | 51.3% | 19.2% | 18.9% | 52.8% | 53.3% |
| 2m+ | 8.7% | 8.2% | 46.2% | 46.6% | 17.2% | 16.4% | 48.1% | 47.8% |

## Appendix 2 Data over Attained Age 100

Table 16 shows the amount of insurance sold by issue age in the 2018–2019 year of experience, as represented by exposure in the first policy year. Very little insurance is sold at age 80, and the number of policies sold drops off very rapidly over that age. There is no exposure for issue ages over 95. Experience for all of these issue ages are included in the main study until after attained age 100. There is too little exposure to infer anything of value from the data over issue age 80.

**Table 16. Exposure in the first policy year, by issue age**

| Issue Age | Female Exposure | | Male Exposure | |
|---|---|---|---|---|
| | Pols | Amt | Pols | Amt |
| 80 | 25.5 | 2,253,952 | 18.5 | 4,660,344 |
| 81 | 10.5 | 1,623,663 | 7.0 | 108,161 |
| 82 | 9.0 | 21,663 | 5.5 | 573,619 |
| 83 | 8.3 | 2,063,632 | 5.0 | 101,754 |
| 84 | 12.0 | 572,810 | 6.0 | 18,072 |
| 85 | 8.0 | 37,041 | 4.0 | 110,238 |
| 86 | 3.0 | 332 | 0.0 | 0 |
| 87 | 1.5 | 359 | 3.0 | 1,700 |
| 88 | 1.5 | 351 | 1.0 | 519 |
| 89 | 0.0 | 0 | 3.0 | 353 |
| 90 | 2.0 | 226 | 0.0 | 0 |
| 91 | 3.0 | 36,219 | 1.0 | 1,750 |
| 92 | 0.0 | 0 | 1.0 | 9,000 |
| 93 | 0.0 | 0 | 0.0 | 0 |
| 94 | 0.0 | 0 | 0.0 | 0 |
| 95 | 0.0 | 0 | 1.0 | 119 |

The exposure in the ultimate period is substantial over age 100, but it is difficult to believe that it can be accurate. Tables 17 and 18 show exposure, deaths, and mortality rates for each attained age 95 to 120, for females and males, respectively. The mortality rates look reasonable until about age 100, but after that they decrease precipitously. The reader is **strongly cautioned against using data over age 100 for any purpose**. As shown in Section 4.9, it is likely that too much of the exposure results from deaths that have not been reported. Incidentally, the submitted data included another 46 records over age 120. All of these are almost certainly from unreported deaths because only Jeanne Calment of France has ever had a verified age of 120 or older.

**Table 17. Female experience in ultimate period, by attained age.**
**WARNING: Data over age 100 is not considered reliable and should not be used for actuarial assumptions**

| | Exposure | | Deaths | | Mortality Rate | |
|---|---|---|---|---|---|---|
| Attained Age | Pols | Amt k$ | Pols | Amt k$ | Pols | Amt |
| 95 | 3,915 | 97,418 | 631 | 15,902 | 0.161 | 0.163 |
| 96 | 2,992 | 58,246 | 558 | 15,918 | 0.187 | 0.273 |
| 97 | 2,342 | 47,542 | 448 | 9,138 | 0.191 | 0.192 |
| 98 | 1,749 | 32,437 | 295 | 5,157 | 0.169 | 0.159 |
| 99 | 1,171 | 17,788 | 216 | 5,547 | 0.184 | 0.312 |
| 100 | 748 | 12,712 | 116 | 2,077 | 0.155 | 0.163 |
| 101 | 539 | 4,294 | 82 | 1,398 | 0.151 | 0.325 |
| 102 | 462 | 3,308 | 60 | 1,118 | 0.129 | 0.338 |
| 103 | 351 | 1,579 | 33 | 191 | 0.094 | 0.121 |
| 104 | 231 | 1,273 | 17 | 79 | 0.071 | 0.062 |
| 105 | 133 | 265 | 7 | 24 | 0.049 | 0.089 |
| 106 | 133 | 1,501 | 7 | 39 | 0.049 | 0.026 |
| 107 | 105 | 285 | 2 | 118 | 0.019 | 0.413 |
| 108 | 73 | 108 | 1 | 1 | 0.014 | 0.009 |
| 109 | 80 | 143 | 0 | 0 | 0.000 | 0.000 |
| 110 | 54 | 101 | 0 | 0 | 0.000 | 0.000 |
| 111 | 55 | 99 | 0 | 0 | 0.000 | 0.000 |
| 112 | 44 | 66 | 0 | 0 | 0.000 | 0.000 |
| 113 | 30 | 57 | 0 | 0 | 0.000 | 0.000 |
| 114 | 26 | 18 | 0 | 0 | 0.000 | 0.000 |
| 115 | 10 | 15 | 0 | 0 | 0.000 | 0.000 |
| 116 | 14 | 29 | 0 | 0 | 0.000 | 0.000 |
| 117 | 9 | 43 | 0 | 0 | 0.000 | 0.000 |
| 118 | 14 | 43 | 0 | 0 | 0.000 | 0.000 |
| 119 | 6 | 11 | 0 | 0 | 0.000 | 0.000 |
| 120 | 2 | 16 | 0 | 0 | 0.000 | 0.000 |

**Table 18. Male experience in ultimate period, by attained age.**
**WARNING: Data over age 100 is not considered reliable and should not be used for actuarial assumptions.**

| | Exposure | | Deaths | | Mortality Rate | |
|---|---|---|---|---|---|---|
| Attained Age | Pols | Amt k$ | Pols | Amt k$ | Pols | Amt |
| 95 | 3,165 | 75,685 | 619 | 15,061 | 0.195 | 0.199 |
| 96 | 2,390 | 53,900 | 485 | 10,832 | 0.203 | 0.201 |
| 97 | 1,742 | 49,029 | 379 | 22,404 | 0.217 | 0.457 |
| 98 | 1,243 | 20,538 | 239 | 4,117 | 0.192 | 0.200 |
| 99 | 821 | 12,146 | 130 | 2,042 | 0.158 | 0.168 |
| 100 | 635 | 6,501 | 75 | 1,571 | 0.118 | 0.242 |
| 101 | 481 | 3,441 | 60 | 1,336 | 0.124 | 0.388 |
| 102 | 417 | 2,686 | 31 | 295 | 0.073 | 0.110 |
| 103 | 365 | 2,923 | 25 | 1,283 | 0.067 | 0.439 |
| 104 | 267 | 724 | 8 | 25 | 0.028 | 0.035 |
| 105 | 187 | 656 | 7 | 83 | 0.035 | 0.127 |
| 106 | 197 | 1,140 | 4 | 3 | 0.018 | 0.003 |
| 107 | 142 | 482 | 1 | 100 | 0.007 | 0.207 |
| 108 | 95 | 215 | 0 | 0 | 0.000 | 0.000 |
| 109 | 74 | 285 | 0 | 0 | 0.000 | 0.000 |
| 110 | 75 | 238 | 1 | 22 | 0.013 | 0.093 |
| 111 | 65 | 186 | 0 | 0 | 0.000 | 0.000 |
| 112 | 52 | 81 | 0 | 0 | 0.000 | 0.000 |
| 113 | 43 | 118 | 0 | 0 | 0.000 | 0.000 |
| 114 | 28 | 133 | 0 | 0 | 0.000 | 0.000 |
| 115 | 18 | 62 | 0 | 0 | 0.000 | 0.000 |
| 116 | 20 | 56 | 0 | 0 | 0.000 | 0.000 |
| 117 | 34 | 336 | 0 | 0 | 0.000 | 0.000 |
| 118 | 35 | 256 | 0 | 0 | 0.000 | 0.000 |
| 119 | 7 | 30 | 0 | 0 | 0.000 | 0.000 |
| 120 | 7 | 21 | 0 | 0 | 0.000 | 0.000 |

# Appendix 3 Data Request

The text of the request for data which was sent to the companies is available upon request.

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