2009-2013 Individual Payout Annuity Mortality Experience Report

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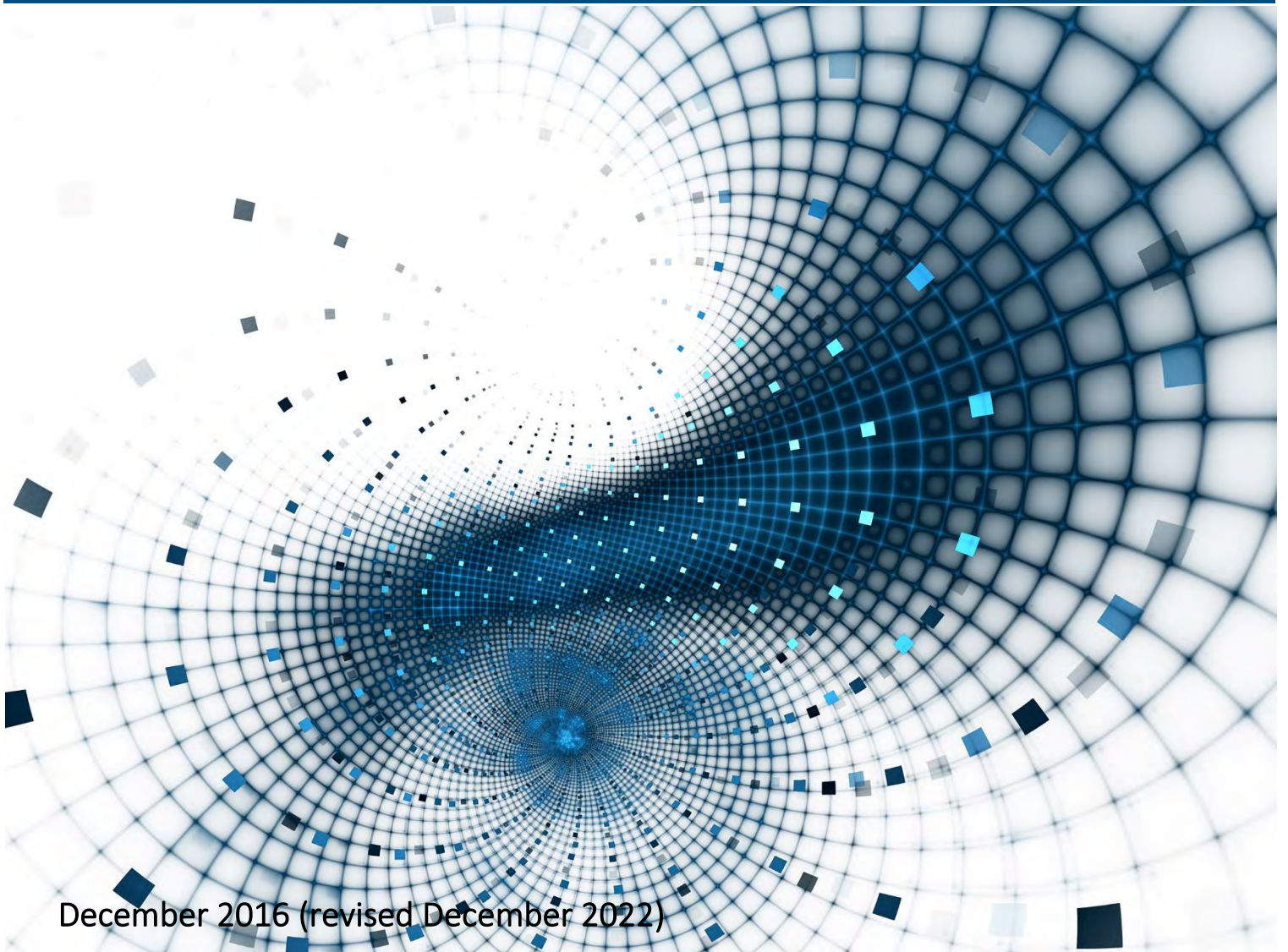
2009-2013 Individual Payout Annuity Mortality Experience Report

Caveat and Disclaimer

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Preface: Revision Made to this Report Subsequent to December 2016

August 2018 Update

- The last sentence of Paragraph 8 of Section 3 was modified to say that the 2009-2013 SSA Table used in this study is the 2011 SSA Table, which represents the midpoint of the experience period.

December 2022 Update

- Actual to Expected ratios by count for the 2009-2013 experience have been updated throughout the report in Tables 1, 3, 4, 5a, 5b, and 16; all Actual to Expected ratios by amount are correct and were not updated. Actual to Expected ratios by count in the previous report mistakenly included exposure for joint lives for the secondary annuitant while in a joint status with the primary annuitant; the Actual to Expected ratios by amount in the previous report reflected the correct exposure subset. Except for Tables 17-18, to reproduce the values in this report using the published pivots, the subset of data for the secondary annuitant mortality while both annuitants are alive (Lives Indicator = 'BS') must be removed.

Section 1: Acknowledgements and Resources

The Society of Actuaries would like to thank the following 21 companies who contributed data to this study:

- **Allstate**
- Columbus Life
- Fidelity Investments
- Integrity Life
- **Lincoln National**
- Massachusetts Mutual
- **MetLife**
- National Integrity Life
- **Nationwide Financial**
- **New York Life**
- **Penn Insurance & Annuity**
- **Penn Mutual Life**
- **Principal Financial**
- Protective Life
- **Prudential**
- **Standard**
- **Thrivent Financial for Lutherans**
- **TIAA-CREF**
- USAA Life
- Western & Southern Assurance
- **Western & Southern Insurance**

Sixteen companies had contributed to the previous study that covered calendar years 2005 through 2008. Thirteen of those companies also contributed to this study, so companies participating in both studies are indicated in bold.

The SOA also extends its gratitude to the Individual Annuity Experience Committee (IAEC). The IAEC designed the project, oversaw the analyses and peer reviewed the report. The IAEC members are:

- Joel Sklar, ASA, MAAA (Chair)
- Sean Souders, FSA, MAAA (Vice-chair)
- Roy Benjamin, FSA, MAAA
- Tom Kukla, FSA, MAAA
- Tony Merse, FLMI
- Keith Osinski, FSA, MAAA
- William Panyard, ASA, MAAA
- Peretz Perl, FSA, MAAA
- Michelle Rosel, FSA, MAAA
- Chris Whitney, FSA, MAAA

Section 2: Purpose of the Study

The primary purposes of this study are:

1. To compare recent annuitant mortality experience with valuation tables.
2. To compare 2009-2013 annuitant mortality experience with that of the 2005-2008 prior study.
3. To compare recent annuitant mortality experience with the new 2012 valuation table with and without the G2 improvement scale.
4. To analyze recent annuitant mortality experience with respect to various annuity benefit types.

No assessment has been made concerning the applicability of this experience to other purposes. In developing this report, the SOA relied upon data and information supplied by the participating company contributors. For each contributor this information includes, but is not limited to, the data submission for mortality experience and the responses to follow-up questions.

General background information on mortality experience credibility is available in Appendix 2 of the Educational Note published by the Canadian Institute of Actuaries. "Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies", Committee on Life Insurance Financial Reporting, Canadian Institute of Actuaries, July 2002.

Section 3: Overview

The Individual Annuity Experience Committee of the Society of Actuaries has conducted an experience study of individual payout annuities, covering calendar years 2009 through 2013. The intent of this study is to provide recent annuitant mortality experience, which can be compared to the 1983 IAM Table, the Annuity 2000 Table and the 2012 IAM Table. The Social Security Administration (SSA) Table will also be used, where applicable. Twenty-one companies contributed data to the study. Sixteen companies had contributed to the previous study that covered calendar years 2005 through 2008. Thirteen companies contributed to both studies.

The current study encompasses over 4.5 million contract-years exposed, about $26.8 billion in annual income-years exposed and over 230,000 deaths over a five-year period. The previous study encompassed over 2.6 million contract-years exposed, over $12.2 billion in annual income-years exposed and over 132,000 deaths and covered four years.

Table 1

Data Comparison	2009-2013	2005-2008
Exposure in contract years	4,494,272	2,636,791
Exposure in annual income years	26,831,330,765	12,202,603,750
Number of deaths	230,019	132,166

The study includes immediate annuities, annuitizations, and life settlement options of life insurance and annuity death claims. To ensure the deaths are reliable, the data reflects annuitants whose payments are life contingent now or will be sometime in the future. Certain period only non-life contingent annuities are excluded. The request for data that went out to companies included standard annuities, but excluded substandard annuities because of the paucity of substandard data. For joint life annuities, the request also included experience data on both lives throughout the contract to enable enhanced experience analysis of the secondary annuitant.

In most of the report, the exposure for joint lives is determined consistently with the approach in the prior report where no recognition is given to the secondary annuitant while in a joint status with the primary annuitant. The additional data on secondary annuitant experience, while in a joint status with the primary annuitant, is used for analysis in Tables 17 and 18 under "A/E Ratios by Benefit Class." When both annuitants are alive, each one is assigned a count of one and 50% of the amount paid under the contract.

Data request also included experience data for variable payout annuities. Because few companies submitted experience on variable payout annuities, these contracts were combined with the fixed payout annuities.

Structured settlement annuities are excluded from this report, as the mortality experience on this specialized block is being compiled and studied separately; a report was published in February 2016 covering the period of 2000-2008 while another one covering years 2009-2013 will be published at about the same time as this report.

An explanation of the exposure calculations with diagrams is available in Appendix A. This is provided to enable readers to draw comparisons of experience derived by different methods than used in this study to their own experience results.

The results of the study are reported through Actual to Expected (A/E) ratios, with expected deaths based on the 1983 Individual Annuity Mortality Table, the Annuity 2000 Mortality Table and the 2012 Individual Annuity Mortality Table. Also, the SSA Tables are used for the global comparison with the previous study. The 2005-2008 SSA Table is the unweighted average of the annual 2005 to 2008 SSA Tables while the 2009-2013 SSA Table used in this study is the 2011 SSA Table, which represents the midpoint of the experience period.

Note that the 1983 IAM, The Annuity 2000 and the 2012 IAM Period tables include the loading of 10% that was deducted from the mortality rates of the basic tables to develop their respective corresponding valuation tables. The 10% loading was not intended to provide for any future improvement in mortality but rather to provide a safety margin to allow for the fact that some companies experience lower than average annuitant mortality.

The 2012 IAM Tables projected using the G2 mortality improvement scale are also used as expected bases. The mortality rates are projected forward and backward, for each of the study years relative to the 2012 baseline.

Table 2

Mortality Table	Valuation Margin	Projection
1983 IAM Table	Included	None
The Annuity 2000 Table	Included	None
2012 IAM Basic Table	None	None
2012 IAM Period Table	Included	None
2012 IAM Basic G2 Table	None	G2
2012 IAM Period G2 Table	Included	G2
2005-2008 SSA Table	None	None
2009-2013 SSA Table	None	None

MIB's Actuarial and Statistical Research Group collected, validated, and summarized the data for this report. In lieu of printed tables, a Microsoft Excel file, published with this report provides Pivot Tables which access the database. These pivot tables can be modified to provide alternate breakdowns and information of interest to the individual user.

Section 4: Format of the Data

All experience is available by amount and by contract. The data are available with the following breakdowns: study year, contract year, gender, annuity type, tax class, contract type, annual income group, attained age group and benefit class as described in Appendix B.

In addition, the database includes a common company indicator that allows the analysis of companies that contributed to both the current and previous studies. By setting the indicator to 1, the database produces data for the 13 companies that contributed to both studies.

The database also includes a "lives" indicator that permits the analysis of each life in a joint life policy separately from the single life policies. There is also a higher level code that distinguishes between single and joint life annuities.

The Committee believes that any lags in the reporting of deaths are minimal at this point and that results are generally credible in the formats provided. Because of low numbers of deaths, results at the very low and very high ages may not be credible. Users who create their own pivot tables from the data should be careful to ensure there is adequate exposure in the resulting cells.

Actual-to Expected (A/E) ratios are available using the 1983 Individual Annuitant Mortality Table (83 IAM), the Annuity 2000 Mortality Table and the 2012 Individual Annuity Mortality Table (2012 IAM). All of these tables are applied on a gender-distinct basis. These sets of tables represent the most recent individual annuity valuation tables and may be downloaded from http://mort.soa.org.

Section 5: Global Comparison with Previous Study

The following table summarizes global Actual-to-Expected (A/E) ratios over the 2009-2013 period and compares them with those of the 2005-2008 period:

Table 3

A/E RATIOS	2009-2013 A/E Ratios		2005-2008 A/E Ratios	
Expected Basis	By Contract	By Amount	By Contract	By Amount
1983 IAM Table	96.5%	86.2%	96.9%	85.1%
The Annuity 2000 Table	113.5%	101.9%	114.0%	101.1%
2012 IAM Basic Table	119.5%	107.2%	121.3%	109.8%
2012 IAM Period Table	132.7%	119.1%	134.8%	122.0%
2012 IAM Basic G2 Table	118.5%	106.4%	115.2%	103.9%
2012 IAM Period G2 Table	131.6%	118.2%	128.0%	115.4%
2005-2008 SSA Table	-	-	77.5%	68.5%
2009-2013 SSA Table	81.8%	73.4%	-	-

There is a slight decrease in the A/E ratios without G2 when expressed by contract. As for the A/E ratios by amount, there is a slight increase for most expected bases used.

When we include only the 13 companies that contributed to both studies, the A/E ratios by contract do not change significantly, while the A/E ratios by amount increase from one study to the next.

Table 4

A/E RATIOS – COMMON COMPANIES	2009-2013 A/E Ratios		2005-2008 A/E Ratios	
Expected Basis	By Contract	By Amount	By Contract	By mount
1983 IAM Table	97.1%	87.6%	96.3%	84.4%
The Annuity 2000 Table	114.2%	103.5%	113.5%	100.4%
2012 IAM Basic Table	120.1%	108.7%	121.3%	109.5%
2012 IAM Period Table	133.5%	120.8%	134.8%	121.7%
2012 IAM Basic G2 Table	119.1%	107.9%	115.0%	103.5%
2012 IAM Period G2 Table	132.3%	119.8%	127.8%	115.0%
2005-2008 SSA Table	-	-	77.1%	68.0%
2009-2013 SSA Table	82.3%	74.5%	-	-

Section 6: Principal Observations

A/E Ratios by Gender

Except when the expected basis is the 1983 IAM Table, the A/E ratios by contract are lower for females than for males. This reversal of the gender A/E relationship for tables after the 1983 IAM is caused by the relatively higher male vs. female mortality improvement reflected in more recent tables and their respective rates.

The difference of rate of change for genders across this time period is shown in Graphs 1 and 2 below where the bulk of the attained ages coincide with the greatest amounts of exposure in the study. As a result, the 2012 tables have proportionately lower male than female mortality rates when compared to the 1983 rates.

Graph 1

Graph 2

1983 IAM qx minus 2012 IAM Period qx as % of 1983 IAM qx
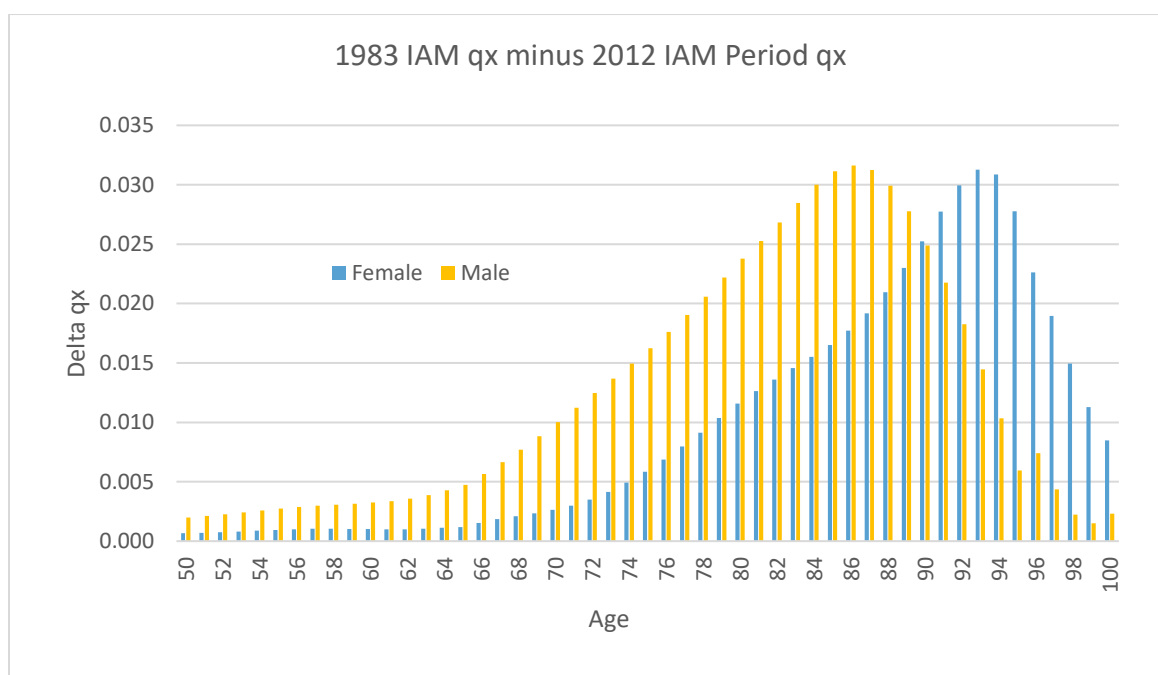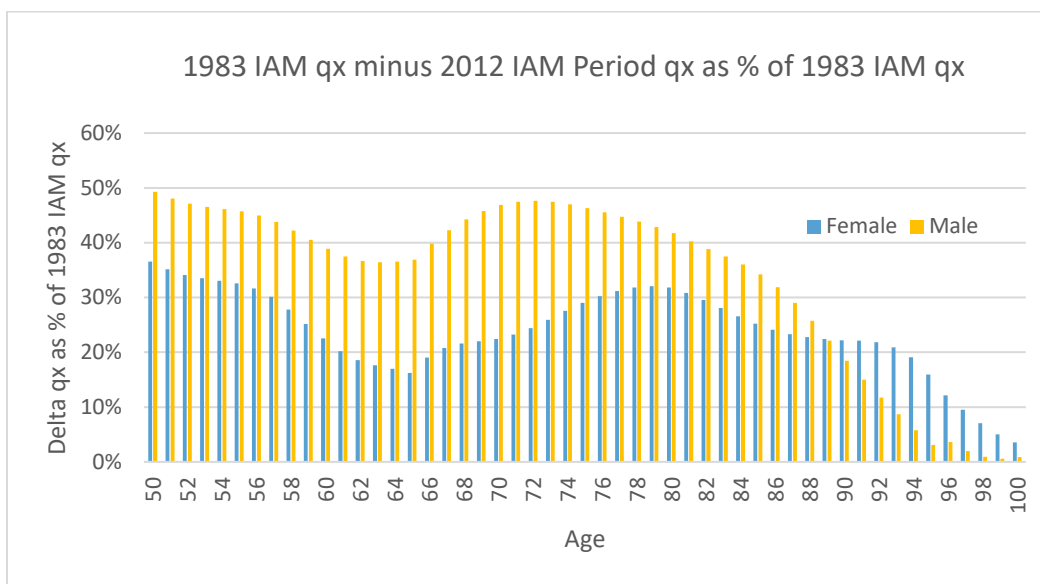
When compared to the previous study, the A/E ratios by contract for females produce an annual mortality improvement varying between 0.13% and 0.22% for static tables. For the males, the annual mortality improvement varies from 0.00% to 0.49%. This is not an absolute comparison given the differences in contributing companies between the two studies.

Table 5a

A/E RATIOS BY GENDER	2009-2013 A/E Ratios by Contract		2005-2008 A/E Ratios by Contract		Annual Mortality Improvement	
Expected Basis	Females	Males	Females	Males	Females	Males
1983 IAM Table	100.8%	92.3%	101.4%	92.3%	0.13%	0.00%
The Annuity 2000 Table	113.6%	113.3%	114.4%	113.6%	0.16%	0.06%
2012 IAM Basic Table	118.3%	120.8%	119.4%	123.5%	0.21%	0.49%
2012 IAM Period Table	131.4%	134.2%	132.7%	137.2%	0.22%	0.49%

When the expected basis is the 2012 IAM Table with G2 improvement scale, there is an incremental deterioration relative to the improvement embedded in the projection scale of 0.64% for females as well as an incremental deterioration of about 0.60% for males.

Table 5b

| A/E RATIOS BY GENDER	2009-2013 A/E Ratios by Contract		2005-2008 A/E Ratios by Contract		Annual Incremental Change	
Expected Basis	Females	Males	Females	Males	Females	Males
2012 IAM Basic G2 Table	117.4%	119.6%	114.1%	116.4%	-0.64%	-0.60%
2012 IAM Period G2 Table	130.4%	132.8%	126.7%	129.3%	-0.64%	-0.59%

Except when the expected basis is the 1983 IAM Table, the A/E ratios by amount are lower for females than for males.

When compared to the previous study, the annual mortality improvement for females is ranging from 0.37% to 0.67% for static tables. By contract, the annual mortality change for males is lower than for females. In fact, the results by amount are all lower than those by contract.

Table 6a

A/E RATIOS BY GENDER	2009-2013 A/E Ratios by Amount		2005-2008 A/E Ratios by Amount		Annual Mortality Improvement	
Expected Basis	Females	Males	Females	Males	Females	Males
1983 IAM Table	90.0%	83.4%	91.5%	80.6%	0.37%	-0.74%
The Annuity 2000 Table	101.3%	102.3%	103.3%	99.4%	0.43%	-0.64%
2012 IAM Basic G2 Table	105.5%	108.7%	108.7%	110.7%	0.67%	0.40%
2012 IAM Period G2 Table	117.2%	120.7%	120.8%	123.0%	0.67%	0.40%

When the expected basis is the 2012 IAM Table with G2 improvement scale, the incremental deterioration relative to the improvement embedded in the projection scale is 0.24% for females and 0.76% for males.

Table 6b

A/E RATIOS BY GENDER	2009-2013 A/E Ratios by Amount		2005-2008 A/E Ratios by Amount		Annual Incremental Change	
Expected Basis	Females	Males	Females	Males	Females	Males
2012 IAM Basic G2 Table	104.8%	107.7%	103.6%	104.1%	-0.24%	-0.76%
2012 IAM Period G2 Table	116.4%	119.7%	115.2%	115.6%	-0.24%	-0.76%

In the rest of this report, for simplicity sake, the analysis is performed on a "by amount" basis only. Anyone interested in a "by contract" analysis may do so using the Excel pivot tables that accompany this report.

A/E Ratios by Refund Feature

The current study continues to show that A/E ratios by amount for non-refund annuities are generally lower than those for refund annuities in the early durations, possibly indicating "self-selection" by annuitants with respect to their health status. The "selection" effect is very noticeable for non-refund annuities, as the A/E ratios in contract years 1-5 are well below the ratios in years 6-10 and beyond (where the impact of selection appears to have worn off to a large extent).

The same pattern is not evident for refund annuities. It is important to note that the refund annuities make up almost 80% of the total experience as shown in Table 8 below. Refund annuities include cash refund, installment refund and life with period certain annuities. The lower ratios for non-refund annuities suggest that the actuary should take into consideration the mix of refund and non-refund annuities in calculating reserves for such contracts.

Table 7

A/E RATIOS BY REFUND FEATURE (BY AMOUNT)	Refund Annuities				Non-refund Annuities			
	Durations				Durations			
Expected Basis	1-2	3-5	6-10	11+	1-2	3-5	6-10	11+
1983 IAM Table	83.2%	90.4%	81.2%	90.5%	37.9%	51.6%	65.6%	95.8%
The Annuity 2000 Table	98.0%	106.5%	96.5%	107.0%	45.1%	61.0%	77.1%	113.0%
2012 IAM Basic Table	103.9%	113.0%	106.8%	111.1%	50.5%	67.1%	80.1%	117.7%
2012 IAM Period Table	115.4%	125.5%	118.6%	123.4%	56.2%	74.5%	89.0%	130.8%
2012 IAM Basic G2 Table	103.0%	112.2%	105.9%	110.2%	49.8%	66.4%	79.5%	116.8%
2012 IAM Period G2 Table	114.5%	124.7%	117.6%	122.5%	55.3%	73.8%	88.3%	129.8%

Table 8

EXPOSURE BY REFUND FEATURE		
Refund Feature	Amount Exposed	%
Refund Annuities	20,751,016,831	77.4%
Non-refund Annuities	6,073,488,181	22.6%
TOTAL	26,824,505,012	100.0%

The differential between refund and non-refund annuities in the current study is larger than in the previous study. The A/E ratios for refund annuities did increase under all expected bases, except for the 2012 IAM expected basis tables without projection G2. The A/E ratios for non-refund annuities only increased under the 2012 IAM expected basis tables with projection G2. The full results are shown in the following table.

Table 9

A/E RATIOS BY REFUND FEATURE (BY AMOUNT)	2009-2013 A/E Ratios		2005-2008 A/E Ratios	
Expected Basis	Refund	Non-refund	Refund	Non-refund
1983 IAM Table	88.5%	78.7%	86.3%	80.0%
The Annuity 2000 Table	104.6%	92.9%	102.7%	94.6%
2012 IAM Basic Table	110.0%	97.9%	111.9%	101.6%
2012 IAM Period Table	122.2%	108.7%	124.3%	112.9%
2012 IAM Basic G2 Table	109.2%	97.0%	105.8%	96.3%
2012 IAM Period G2 Table	121.3%	107.8%	117.5%	107.0%

A/E Ratios by Refund Feature and Tax Class

Table 10 examines the A/E ratios by tax class. For this analysis, IRAs have been included with qualified business. In the past, the differences in A/E ratios between non-refund and refund annuities were more pronounced for non-qualified business than for qualified business. This continues to be the case for the current study.

Table 10

A/E RATIOS BY REFUND FEATURE AND TAX CLASS (BY AMOUNT)						
	Refund Annuities			**Non-refund Annuities**		
Expected Basis	**Qualified**	**Non-qualified**	**TOTAL**	**Qualified**	**Non-qualified**	**TOTAL**
1983 IAM Table	85.0%	96.8%	88.5%	88.5%	65.3%	78.7%
The Annuity 2000 Table	101.2%	112.6%	104.6%	105.2%	76.3%	92.9%
2012 IAM Basic Table	108.0%	114.6%	110.0%	112.8%	78.5%	97.8%
2012 IAM Period Table	119.9%	127.4%	122.2%	125.3%	87.2%	108.7%
2012 IAM Basic G2 Table	107.0%	114.0%	109.2%	111.8%	77.9%	97.0%
2012 IAM Period G2 Table	118.9%	126.6%	121.3%	124.2%	86.6%	107.8%

For this analysis, qualified business represents about 70% of refund and non-refund annuities whether expressed by exposure amount or death amount. The A/E ratios are higher for non-qualified refund annuities. For non-refund annuities, the A/E ratios are higher for qualified business.

A/E Ratios by Contract Type

Table 11 examines the A/E ratios by contract type, that is for immediate annuities, annuitizations, and settlement options. A/E ratios are lowest for immediate annuities and highest for the various types of settlement options. For all contract types, the A/E ratios are highest under the 2012 IAM Period Tables.

Table 11

A/E RATIOS BY CONTRACT TYPE (BY AMOUNT)			
Expected Basis	Immediate Annuities	Annuitizations	Settlement Options
1983 IAM Table	82.8%	86.8%	96.4%
The Annuity 2000 Table	97.3%	102.9%	112.2%
2012 IAM Basic Table	102.6%	108.4%	115.5%
2012 IAM Period Table	113.9%	120.4%	128.3%
2012 IAM Basic G2 Table	101.9%	107.5%	114.6%
2012 IAM Period G2 Table	113.2%	119.4%	127.4%

A/E Ratios by Annual Income Group

Table 12 examines the A/E ratios by annual income group. The study results show a strong indication of "self-selection" by annual annuity income levels with significantly lower A/E ratios for the higher income bands and with the A/E ratios decreasing steadily as the income band increased.

Table 12

A/E RATIOS BY INCOME GROUP (BY AMOUNT)									
ANNUAL INCOME GROUPS									
Expected Basis	Up to $2,499	$2,500 - $4,999	$5,000 - $7,499	$7,500 - $9,999	$10,000 - $14,999	$15,000 - $24,999	$25,000 - $49,000	$50,000+	TOTAL
1983 IAM Table	99.7%	93.2%	89.4%	87.0%	86.5%	85.8%	83.8%	74.1%	**86.2%**
The Annuity 2000 Table	116.8%	109.6%	105.5%	102.7%	102.2%	101.8%	99.4%	87.4%	**101.9%**
2012 IAM Basic Table	122.4%	116.1%	111.9%	109.4%	108.5%	107.8%	104.5%	89.3%	**107.2%**
2012 IAM Period Table	136.0%	129.0%	124.3%	121.5%	120.5%	119.8%	116.1%	99.3%	**119.1%**
2012 IAM Basic G2 Table	121.3%	115.1%	111.0%	108.5%	107.6%	107.0%	103.7%	88.8%	**106.4%**
2012 IAM Period G2 Table	134.8%	127.9%	123.3%	120.5%	119.5%	118.8%	115.3%	98.6%	**118.2%**

Table 13 examines the same A/E ratios by annual income group for males. For male lives, overall A/E ratios decrease monotonically with increasing annual income bands for each expected basis.

Table 13

A/E RATIOS BY INCOME GROUP (BY AMOUNT) - MALES								
ANNUAL INCOME GROUPS								
Expected Basis	**Up to $2,499**	**$2,500 - $4,999**	**$5,000 - $7,499**	**$7,500 - $9,999**	**$10,000 - $14,999**	**$15,000 - $24,999**	**$25,000 - $49,000**	**$50,000+**	**TOTAL**
1983 IAM Table	96.8%	91.3%	87.3%	85.3%	84.3%	81.9%	80.1%	74.0%	**83.4%**
The Annuity 2000 Table	118.8%	112.2%	107.3%	104.9%	103.6%	100.6%	98.3%	90.3%	**102.3%**
2012 IAM Basic Table	125.6%	120.6%	115.6%	113.6%	111.5%	108.1%	104.2%	91.7%	**108.7%**
2012 IAM Period Table	139.5%	134.0%	128.4%	126.2%	123.9%	120.1%	115.8%	101.9%	**120.7%**
2012 IAM Basic G2 Table	124.3%	119.4%	114.4%	112.5%	110.5%	107.1%	103.4%	91.0%	**107.7%**
2012 IAM Period G2 Table	138.1%	132.6%	127.2%	125.0%	122.8%	119.0%	114.9%	101.1%	**119.7%**

Table 14 examines the same A/E ratios by annual income group for females. The same trend of decreasing A/E ratios with increasing annual income bands is observed for female lives.

Table 14

A/E RATIOS BY INCOME GROUP (BY AMOUNT) - FEMALES								
ANNUAL INCOME GROUPS								
Expected Basis	**Up to $2,499**	**$2,500 - $4,999**	**$5,000 - $7,499**	**$7,500 - $9,999**	**$10,000 - $14,999**	**$15,000 - $24,999**	**$25,000 - $49,000**	**$50,000+**	**TOTAL**
1983 IAM Table	102.2%	95.1%	91.8%	88.9%	89.2%	91.8%	90.1%	74.2%	**90.0%**
The Annuity 2000 Table	115.2%	107.2%	103.6%	100.3%	100.6%	103.4%	101.3%	83.3%	**101.3%**
2012 IAM Basic Table	119.9%	112.2%	108.3%	104.9%	104.9%	107.5%	104.9%	86.0%	**105.5%**
2012 IAM Period Table	133.2%	124.7%	120.3%	116.5%	116.5%	119.4%	116.6%	95.6%	**117.2%**
2012 IAM Basic G2 Table	118.9%	111.4%	107.5%	104.2%	104.2%	106.8%	104.3%	85.6%	**104.8%**
2012 IAM Period G2 Table	132.1%	123.7%	119.4%	115.7%	115.8%	118.7%	115.9%	95.1%	**116.4%**

The pattern was quite similar in the prior studies. This pattern suggests that the actuary should take extra care in the setting of premiums and reserves for annuities of larger amounts.

A/E Ratios by Attained Age Group

Table 15 examines the A/E ratios by attained age groups. The number of deaths before the attained age group 51-54 is too low to be credible, so the table only considers attained ages 51 and over.

By looking at Graph 3, the A/E ratios show a bump at the attained age group 55-59. Following that, the A/E ratios show a drop in the next age group and then are level for both 2012 bases and concave for the 1983 and 2000 tables. The difference of the slopes of the 1983 and 2000 A/E ratios compared to the 2012 A/E ratios reflect mortality improvement that has occurred since the earlier tables were established.

Table 15

A/E RATIOS BY ATTAINED AGE GROUP (BY AMOUNT)											
ATTAINED AGE GROUPS											
Expected Basis	51-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100+	TOTAL
1983 IAM Table	94.0%	125.7%	84.3%	75.5%	67.8%	70.8%	75.2%	87.6%	99.2%	116.4%	113.3%	86.2%
The Annuity 2000 Table	120.2%	157.2%	104.9%	93.8%	82.6%	85.4%	90.4%	103.3%	113.9%	132.6%	128.7%	101.9%
2012 IAM Basic Table	146.0%	180.9%	108.7%	105.4%	102.7%	106.7%	104.4%	107.0%	108.2%	113.8%	104.9%	107.2%
2012 IAM Period Table	162.2%	201.0%	120.8%	117.1%	114.1%	118.5%	116.0%	118.9%	120.2%	126.5%	116.3%	119.1%

Graph 3
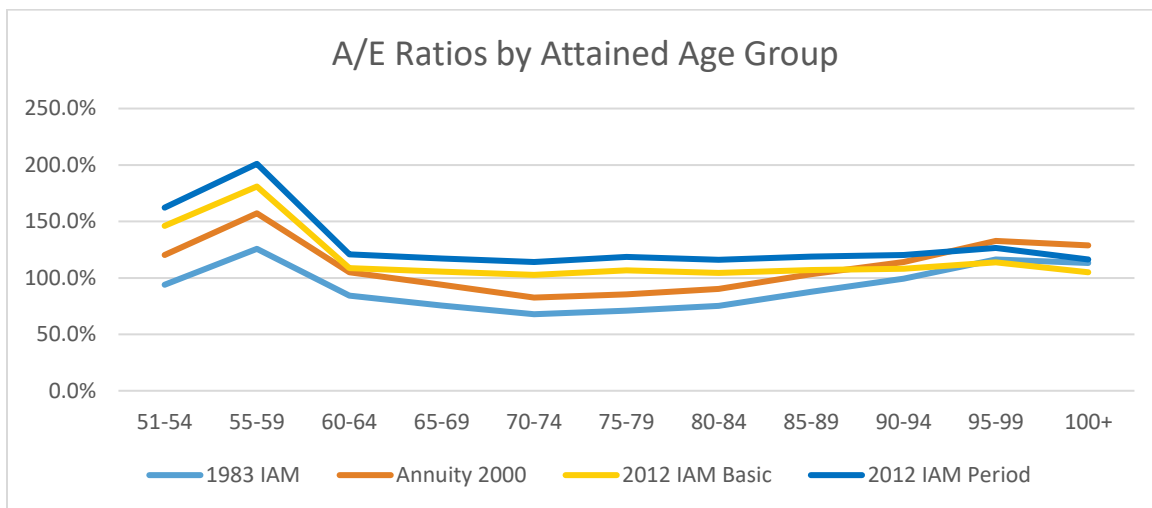
A/E Ratios by Benefit Class

Table 16 examines the A/E ratios by benefit class. The number of deaths is a bit higher for single life than for joint life annuities. The A/E ratios are always higher for single life annuities regardless of the expected basis used.

Table 16

A/E RATIOS BY BENEFIT CLASS (BY CONTRACT)		
	Number of Deaths	Number of Deaths
	130,982	98,941
Expected Basis	Single Life Annuities	Joint Life Annuities
1983 IAM Table	102.4%	89.7%
The Annuity 2000 Table	119.3%	106.7%
2012 IAM Basic Table	124.3%	113.7%
2012 IAM Period Table	138.1%	126.3%
2012 IAM Basic G2 Table	123.3%	112.6%
2012 IAM Period G2 Table	136.9%	125.1%

Table 17 examines the A/E ratios of joint life annuities according to the following definition of the "lives" indicator:

- BP is for the primary annuitant mortality while both annuitants are alive.
- BS is for the secondary annuitant mortality while both annuitants are alive.
- P is for the primary annuitant mortality after the secondary annuitant dies.
- S is for the secondary annuitant mortality after the primary annuitant dies.

Table 17

A/E RATIOS FOR JOINT LIFE ANNUITIES (BY CONTRACT)					
	Number of Deaths				
	46,912	30,013	22,812	29,217	128,954
Expected Basis	BP	BS	P	S	TOTAL
1983 IAM Table	77.7%	73.6%	108.4%	101.3%	85.4%
The Annuity 2000 Table	94.7%	86.1%	128.0%	115.0%	101.0%
2012 IAM Basic Table	105.1%	93.6%	128.0%	118.7%	108.3%
2012 IAM Period Table	116.8%	104.0%	142.3%	131.9%	120.3%
2012 IAM Basic G2 Table	104.0%	92.6%	127.1%	117.9%	107.2%
2012 IAM Period G2 Table	115.5%	102.9%	141.2%	131.0%	119.2%

The primary annuitant, either in a joint or survivor status, has higher A/E ratios than the secondary annuitant.

When both annuitants are alive, A/E ratios are much lower. This would support the theory that the survivor annuitant has higher mortality than when both annuitants are alive.

There are two possible simultaneously occuring effects that cause this.

1) Survivors sometimes experience worse mortality after the loss of a spouse. As shown in Table 18 below using for illustration the 2012 IAM Basic expected basis, the A/E ratio for both males and females is higher in a survivor than joint status for all contract year groups. These results should be taken with care because of potential underreporting of secondary annuitant mortality when the secondary annuitant predeceases the primary annuitant and due to low numbers of deaths in certain cells.

2) A contributing, but less significant, factor is that survivors are, on average, in later policy years than when in a joint status where the duration effect leads to higher A/E ratios. However, the effect is not as strong as 1) because the duration effect itself diminishes at higher ages.

Table 18

Gender	Lives Indicator	Number of Deaths					A/E Ratio by Contract 2012 IAM Basic				
		Contract Years					Contract Years				
		1-2	3-5	6-10	11+	TOTAL	1-2	3-5	6-10	11+	TOTAL
Female	BP	467	730	919	4,472	6,588	76.2%	87.2%	89.6%	98.6%	94.0%
	BS	893	1,437	1,937	14,553	18,820	63.9%	76.0%	78.8%	91.5%	87.0%
	P	16	98	262	7,466	7,842	143.4%	134.2%	107.9%	119.7%	119.4%
	S	35	251	639	24,430	25,355	129.1%	135.1%	116.8%	116.9%	117.0%
	TOTAL	1,411	2,516	3,757	50,921	58,605	68.9%	84.2%	87.9%	107.0%	103.0%
Male	BP	2,293	3,183	4,346	30,502	40,324	98.4%	101.8%	105.1%	108.9%	107.2%
	BS	711	1,251	1,673	7,558	11,193	86.2%	107.4%	105.8%	110.5%	107.5%
	P	32	241	527	14,170	14,970	126.7%	179.9%	143.8%	132.1%	133.1%
	S	8	83	218	3,553	3,862	109.5%	176.3%	138.8%	130.2%	131.3%
	TOTAL	3,044	4,758	6,764	55,783	70,349	95.5%	106.3%	108.4%	115.5%	113.1%
All	BP	2,760	3,913	5,265	34,974	46,912	93.8%	98.7%	102.0%	107.4%	105.1%
	BS	1,604	2,688	3,610	22,111	30,013	72.2%	88.0%	89.4%	97.2%	93.6%
	P	48	339	789	21,636	22,812	131.8%	163.8%	129.5%	127.6%	128.0%
	S	43	334	857	27,983	29,217	124.9%	143.4%	121.7%	118.4%	118.7%
	TOTAL	4,455	7,274	10,521	106,704	128,954	85.1%	97.5%	100.1%	111.3%	108.3%

Appendix A — Exposure Calculations - Mortality

1. Overview

For the statistical agent data, the data is submitted by calendar year split into two policy durations. For mortality, the Balducci approach is used. Therefore, the exposure assigned to a death will differ depending upon whether mortality is the decrement under study. The duration that a termination is assigned to is based on the Actual Termination Date. See the diagram below.

Each submitted record is split into two portions that correspond to the two policy durations:

- **B:** The policy duration before the anniversary date in the calendar year (Before Analytical Anniversary Portion = 'B'), and
- **A:** The policy duration after the anniversary date in the calendar year (After Analytical Anniversary Portion = 'A').

For example, a record submitted with the annuitant having a duration of 10 at the beginning of the observation year would have a Before Analytical Anniversary Portion of 'B' with a duration of 10 and the Analytical Anniversary Portion of 'A' would have a duration of 11.

Based on the two Analytical Anniversary Portions, we calculate Exposure Length for mortality. Then, we calculate the Policies Exposed, Annuity or Reserve Amount, and the Amount Exposed.

2. Mortality Exposure Length

The Exposure Length differs between the After Analytical Anniversary Portion 'A' and the Before Analytical Anniversary Portion 'B' for in force, death terminations and non-death terminations. The Exposure Length is used to determine the Policies Exposed and the Annuity or Reserve Amount Exposed.

2.1 For In Force Policies

The Exposure Length of the Before Analytical Anniversary Portion 'B' is the fraction of the year from the beginning of the calendar year to the Anniversary Date of the policy in the Observation Year. For After Analytical Anniversary Portion 'A,' the Exposure Length is the fraction of the year from the anniversary date of the policy during the calendar year to the end of the calendar year.

2.2 For Death Terminated Policies

The calculation of Exposure Length depends upon whether the death occurred before the anniversary date or after the anniversary date:

- If the death occurs before the anniversary date, due to the Balducci hypothesis, the exposure length for 'B' is the fraction of the year from the beginning of the calendar year to the anniversary date in the Observation Year. The exposure length for the After Analytical Anniversary Portion 'A' would be zero.
- If the death occurs after the anniversary date, the exposure length for 'B' is the fraction of the year from the beginning of the calendar year to the anniversary date in the Observation Year. Due to the Balducci hypothesis, the exposure length for the After Analytical Anniversary Portion 'A' would be 1.

2.3 For Non-Death Terminated Policies

The calculation of Exposure Length depends upon whether the non-death termination occurred before or after the anniversary date:

- If the non-death terminations occur before the anniversary date, the exposure length for the Before Analytical Anniversary Portion 'B' is the fraction of the year from the beginning of the calendar year to the Actual Termination Date. The exposure length for the After Analytical Anniversary Portion 'A' would be zero.
- If the non-death termination occurs after the anniversary date, the exposure length for the Before Analytical Anniversary Portion 'B' is the fraction of the year from the beginning of the calendar year to the anniversary date in the Observation Year. The exposure length for the After Analytical Anniversary Portion 'A' would be the fraction of the year from the anniversary date to the Actual Termination Date.

3. Policies Exposed

Policies Exposed is calculated as the product of the Policy Exposure Indicator (PEI) and Exposure Length. For single life policies, the PEI is set to 1 for the base policy (Segment Number = 1) and PEI is set to 0 for non-base policy (Segment Number > 1).

4. Annuity or Reserve Amount

Annuity or Reserve Amount is based upon the Amount at the Beginning of the Year or the Amount at the End of the Year.

For the Analytical Anniversary Portion 'B,' the Annuity or Reserve Amount is based upon the Amount at the Beginning of the Year. For the Analytical Anniversary Portion 'A,' the Annuity or Reserve Amount is based upon the Amount at the End of the Year.
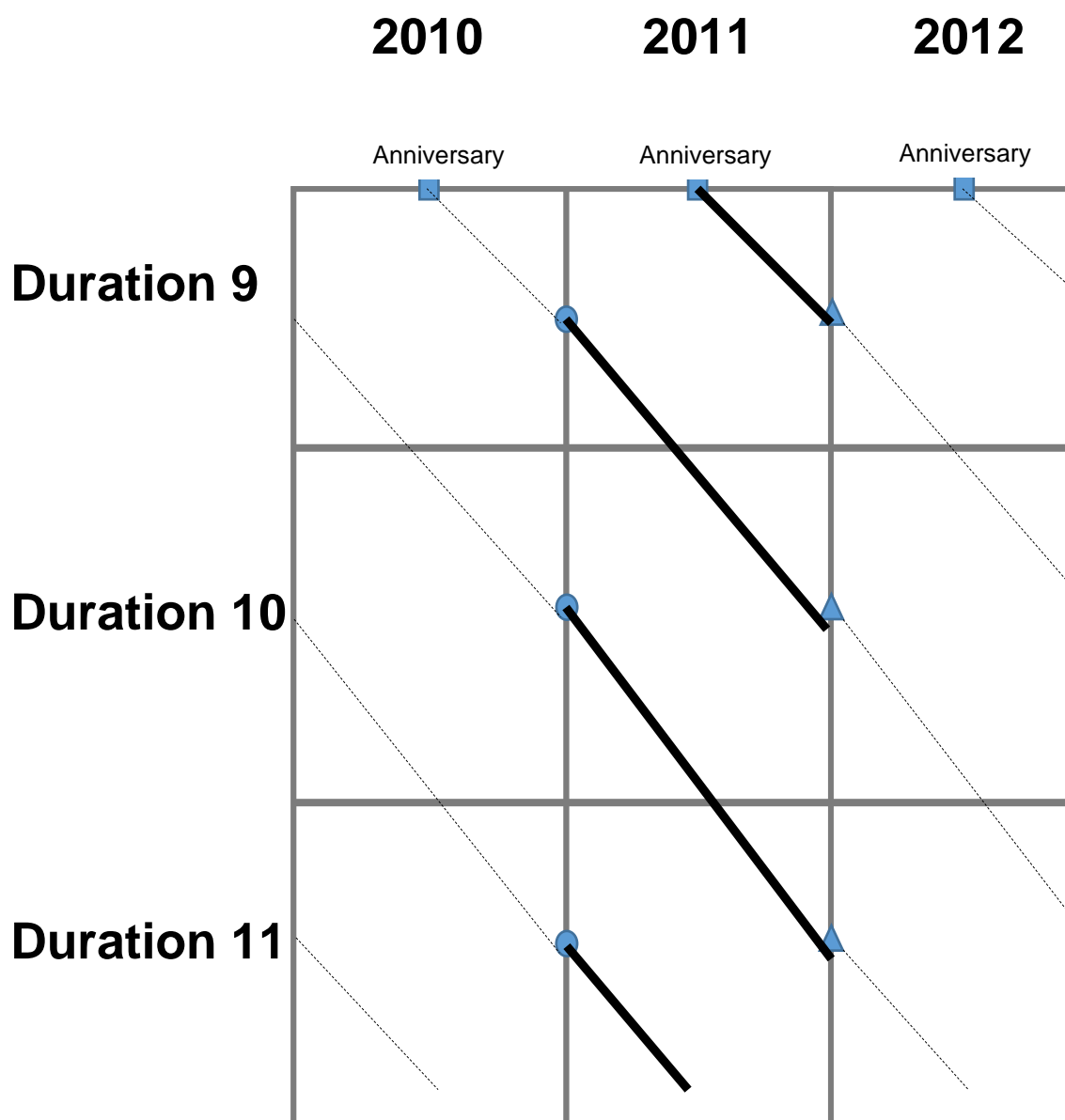
5. Amount Exposed

The Amount Exposed is calculated as the product of the Exposure Length and Annuity or Reserve Amount.
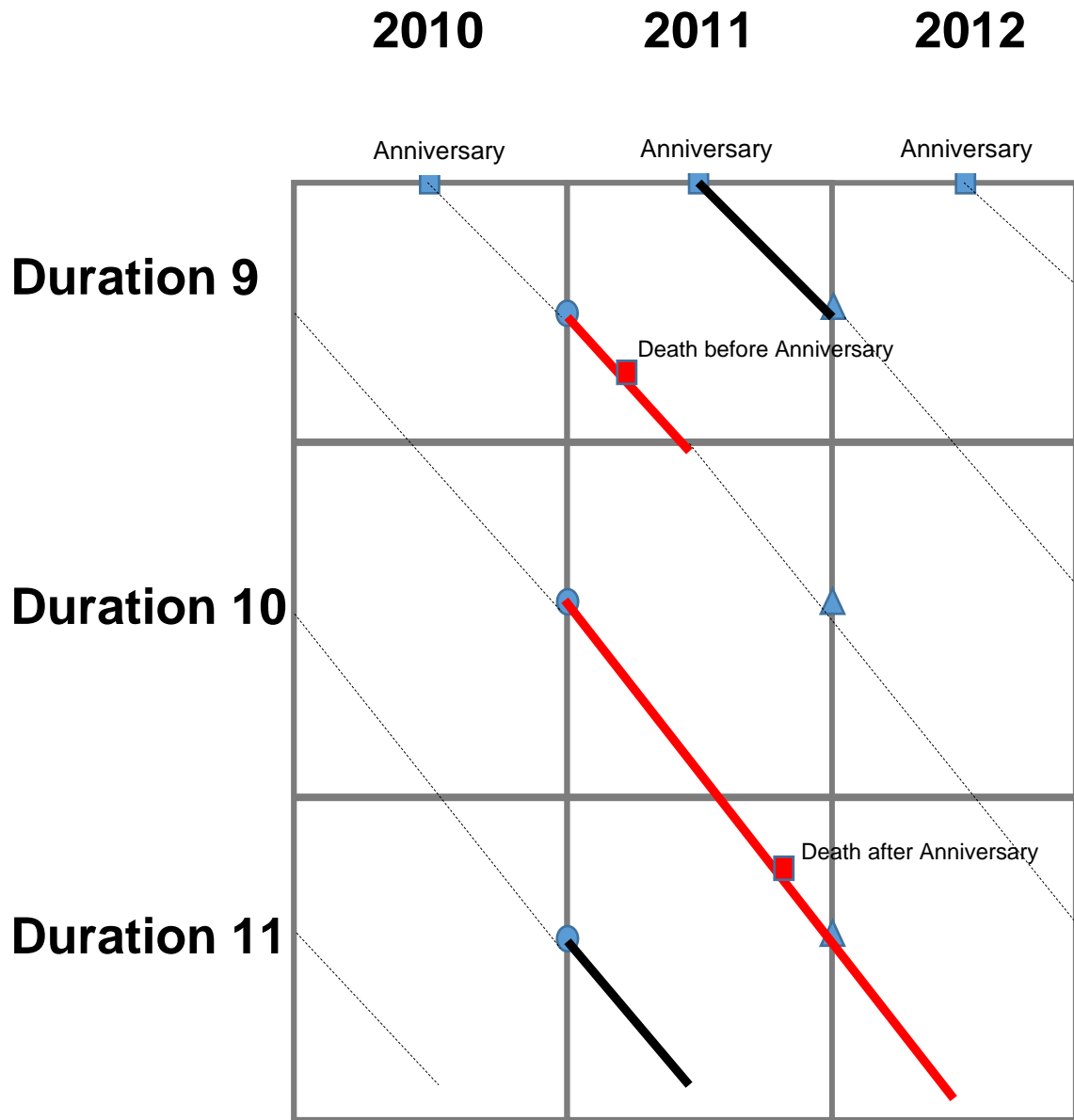
Diagrams
Exposure for Policy Duration
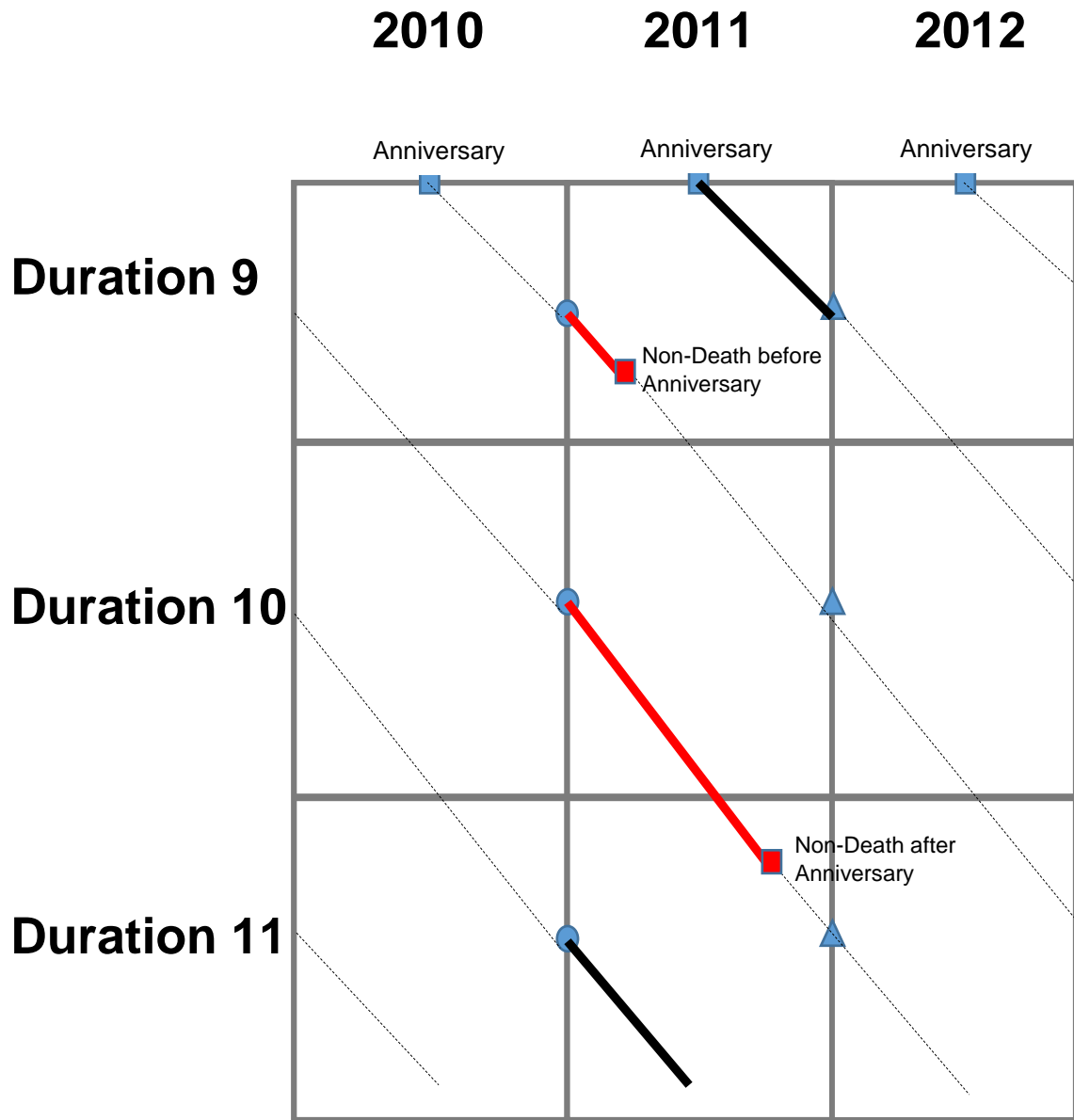# in Calendar Year 2011

For In Force Policies

	2010	**2011**	**2012**
	Anniversary	Anniversary	Anniversary

Duration 9

Duration 10

Duration 11

For Death Terminated Policies

2010   **2011**   **2012**

Anniversary   Anniversary   Anniversary

Duration 9

Death before Anniversary

Duration 10

Death after Anniversary

Duration 11

For Non-Death Terminated Policies

	2010	2011	2012
	Anniversary	Anniversary	Anniversary
Duration 9			
Duration 10			
Duration 11			

Non-Death before Anniversary

Non-Death after Anniversary

Appendix B — Fixed Variables

Study year: 2009, 2010, 2011, 2012, 2013

Contract year: 1-2, 3-5, 6-10, 11+

Gender: Female, Male

Refund feature: Non Refund, Refund, Refund period certain

Tax class: Life insurance settlements, Non-qualified, Qualified other than pension trust, Pension trust, IRA

Contract type: Immediate annuity
Annuitization of a deferred annuity
Settlement option of annuity death claim
Settlement option of life insurance death claim
Settlement option of life insurance maturity or surrender
Deferred income annuity

Annual Income   Up to $2,499, $2,500-$4,999, $5,000-$7,499, $7,500-$9,999, $10,000-$14,999,

group: $15,000-$24,999, $25,000-$49,999, $50,000+

Attained age   0-5, 6-10, 11-15, 16-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50,
group: 51-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, 90-94, 95-99,
100+

Benefit Class:

Single life	Joint life
Single life only	Joint & survivor
Single life with period certain	Joint & survivor with period certain
Single life with cash refund	Joint & survivor with cash refund
Single life with installment refund	Joint & survivor with installment refund
Temporary single life	

Common company indicator: 0 (not common) or 1 (common)

Lives Indicator: BP for primary annuitant mortality while both annuitants are alive
BS for secondary annuitant mortality while both annuitants are alive
JL for joint life policies (for the 2005-2008 study period only)
NA for single life policies (for the 2005-2008 study period only)
P for primary annuitant mortality after the secondary annuitant dies
S for secondary annuitant mortality after the primary annuitant dies

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