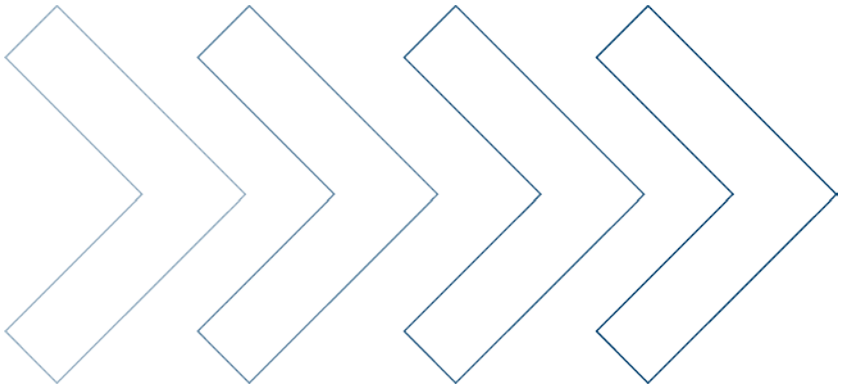
SOCIETY OF ACTUARIES



Individual Life Experience Committee

Mortality Data Preparation and Adjustment Report

December 2017

Individual Life Experience Committee

Mortality Data Preparation and Adjustment Report

Caveat and Disclaimer

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Section 1: Background and Scope

This report describes the sources, methodology and adjustments that were made to prepare the data used for the SOA's Individual Life Experience Committee (ILEC) mortality study covering observation years 2003 to 2013. A separate Excel workbook provides details of the data elements and a description of the key considerations to interpret the data.

For observation years 2003 to 2009, the ILEC released 4 mortality studies/reports:

1. the 2002-2004 Individual Life Experience Report,
2. the 2004-2005 Individual Life Experience Report,
3. the 2005-2007 Individual Life Experience Report, and
4. the 2007-2009 Individual Life Experience Report.

These reports were all on a policy year end basis.

New York State started contributing mortality data to the Life Statistical Services' (LSS) mandatory data call with calendar year 2009. Kansas State contributed starting with calendar year 2011. From the LSS data call then, 5 years' worth of calendar year data was included in the 2003-13 report.

Since Kansas State started contributing only in calendar year 2011, the SOA conducted a separate data call for the Kansas companies asking them to voluntarily contribute data for calendar years 2009 and 2010. Only a third of the Kansas companies contributed to this data call.

The data from the ILEC submissions, from observation years 2003 to 2009 was combined with the LSS submissions from 2009 to 2013, to give observation years 2003 to 2013.

This data can be used to reproduce data used for various past analyses:

- 2002-2004 Individual Life Experience Report
- 2004-2005 Individual Life Experience Report
- 2005-2007 Individual Life Experience Report
- 2007-2009 Individual Life Experience Report
- 2015 VBT Report
    - *In order to reproduce the counts and exposures shown in the 2015 VBT report, the following filter should be included for both the adult aggregate file and the juvenile smoker unknown file:*
        - *ILEC 02-09 aggregate data*
        - *LSS 09 aggregate data*

Section 2: Acknowledgements and Resources

2.1 Individual Life Experience Committee

The SOA extends its gratitude to the Individual Life Experience Committee (ILEC). The ILEC designed the project, completed/oversaw the analyses and authored and peer reviewed the report. The ILEC members are:

Dieter Gaubatz, FSA, FCIA, MAAA, Chair
Tony Phipps, FSA, MAAA, Vice-Chair
Mary Bahna-Nolan, FSA, MAAA, CERA
Tatiana Berezin, FSA, MAAA
Chris Condon, FSA, MAAA
Jeff Dukes, FSA, MAAA
Roland Fawthrop, FSA, MAAA
Brian Holland, FSA, MAAA
Ed Hui, FSA
Doug Ingle, Underwriter
Kevin Larsen, ASA, MAAA
Hezhong (Mark) Ma, FSA, MAAA
Steve MacDonald, Underwriter
Mark Rosa, ASA, MAAA
Nikolai Serykh, FSA, FCIA
Frans Te Groen, FSA, MAAA
Maureen Shaughnessy, FSA, MAAA
Ed Wright, FSA, MAAA

2.2 Other Resources

The SOA contracted with MIB's Actuarial and Statistical Research Group, to collect, validate, and compile the data for this report. MIB staff members drafted the contents of this report. Mervyn Kopinsky, SOA Experience Studies Actuary and Korrel Rosenberg, SOA Senior Research Administrator, supplied SOA staff support.

Section 3: Detailed Data Description

3.1 Observation Years

Data was collected for the time period 2002 to 2013.

Data from 2002 to 2009 was from the ILEC voluntary studies for 2002-04, 2004-05, 2005-07 and 2007-09. Calendar year and policy year submissions were processed and reported on a policy year end (PYE) basis, hereafter referred to as PYE 2003, PYE 2004 and so on to PYE 2009 or PYE 2003-09.

Data for observation periods 2009 to 2013 was from the LSS mandatory collection for New York State from 2009 to 2013 and Kansas State from 2011 to 2013. Submissions here were collected and processed on a calendar year basis.

3.2 Kansas Backfill Data Call

Since Kansas only started contributing mandatory data in 2011, 2 years behind New York, the SOA conducted a voluntary data call for Kansas for observation years 2009 and 2010. Only about a third of the Kansas companies submitted data voluntarily.

3.3 Processing Submissions

As indicated in section 3.1, not all companies in the ILEC studies submitted data uniformly. Companies submitted either on a calendar year basis or a policy year basis.

Submissions on a calendar year basis were transformed into policy year submissions by breaking them up into before anniversary (BA) and after anniversary (AA) segments or portions. The BA segment is from January 1 to the policy anniversary while the AA segment is from the policy anniversary to the end of the year. For example, the calendar years 2002 and 2003 submissions were broken up into BA 2002 or BA 02 and AA 2002 or AA 02 and BA 2003 or BA 03 and AA 2003 or AA 03. The PYE 2003 submission starts from the anniversary in 2002 to the anniversary in 2003 and so is made up of segments AA 02 and BA 03. The PYE 2004 is composed of segments AA 03 and BA 04, and so on. The PYE 2009 is composed of segments AA 08 and BA 09. The segments BA 02 and AA 09, one year's worth of exposure, were discarded since they did not fall into any policy year within the study period.

Submissions on a policy year basis were also broken up into segments: after anniversary and before anniversary. PYE 2003 submission was composed of, using the same notation as above, AA 02 and BA 03. PYE 2009 was composed of AA 08 and BA 09. Nothing was discarded for policy year submissions.

3.4 Source Names and Description of Data

The pivot tables and CSV files contain 3 different source names. Data was collected from either earlier ILEC studies (2002 –2009) or mandatory data calls (2009 – 2013), with some complications arising from the 2009 submissions due to potential overlapping submissions. The data included in each of the source names is described below. The diagram below the descriptions shows graphically how the data is reflected in the different source names.

1. **ILEC 02-09.** The "source name" field for ILEC PYE 2003-09 was set to "ILEC 02-09". The source name field is a field in the pivot tables that you can filter on to view either the results from the ILEC study only or from the LSS study only.

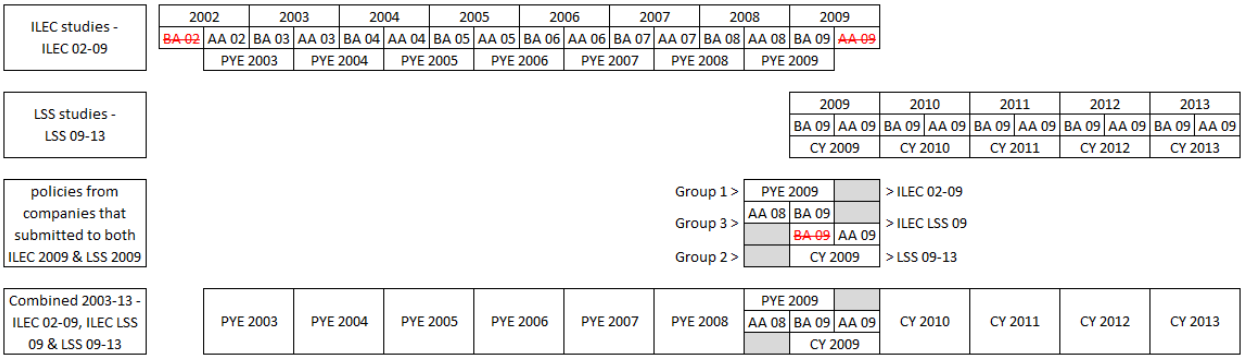
2. **LSS 2009-13.** The "source name" field for the mandatory data calls for 2009-13 was set to "LSS 2009-13".

   Submissions in the 2009 to 2013 New York and Kansas mandatory data calls and the 2009 and 2010 Kansas backfill data call were submitted on a calendar year basis and processed on a calendar year basis. This means no exposure was excluded for these mandatory data calls. Similar to what was done with the calendar year submissions in the ILEC studies, calendar year submissions for LSS were broken up into before anniversary and after anniversary segments. For calendar year 2009, for example, there are segments BA 09 and AA 09. For calendar year 2013, there are segments BA 13 and AA 13.

3. **ILEC LSS 09.** For the companies that submitted in both ILEC and mandatory data calls for 2009, additional measures were taken to ensure that policies were not included twice in ILEC PYE 2009 and then again in the LSS data call for 2009. Policies submitted by companies in ILEC 2009 and LSS 2009 were split into 3 groups of policies: Group 1 - for policies that were in the ILEC 2009 submission only; Group 2 - for policies that were in the LSS 2009 submission only; and, Group 3 - for policies that showed up in both ILEC 2009 and LSS 2009. Since ILEC 2009 is by policy year (with segments AA 08 and BA 09) and LSS 2009 is by calendar year (with segments BA 09 and AA 09) the two records overlap with segment BA 09 being the overlap. To avoid double counting this overlap, BA 09 from the mandatory data call was discarded, leaving us with segments AA 08 and BA 09 from the ILEC 2009 record and segment AA 09 from the LSS 2009 record. These segments were given source names "ILEC 2003-09" for segment AA 08, "ILEC LSS 09" for segment BA 09 and "LSS 2009-13" for segment AA 09.

To view only the experience from the ILEC PYE 2003-09, filter on the source field for "ILEC 2003-09" and "ILEC LSS 09". To view only the experience from the mandatory data calls for 2009-13, filter on the source field for "ILEC LSS 09" and "LSS 2009-13".

Here's a diagram of the process above:



Important note about policy and calendar years. While the ILEC studies remained on a policy year basis, the LSS study is on a calendar year basis. Keep this in mind when analyzing the combined pivot tables since the "study years" there are referred to as "observation years".

3.5 Common Company Indicator

Because very few companies contributed to every year of the study, the ILEC decided to relax the definition of a common company to those that contributed in at least 4 of the 7 years in the ILEC study and in at least 3 of the 5 years in the LSS study. As indicated above, the 4 ILEC studies from 2002 to 2009 were combined to give the ILEC study from 2002 to 2009. Not all companies submitted in these 4 studies and only a few of them contributed in all 7 years of the ILEC study.

Similarly for the LSS studies - as indicated above, NY started contributing in 2009 and KS started in 2011. The SOA conducted a voluntary study for KS to ask them for their 2009 and 2010 submission but only a third of the companies submitted.

Moreover, not all companies that submitted to the LSS study also submitted to the ILEC studies. To set a true common company indicator then, a company that contributed in all 11 years, would result in only a handful of "true" common companies.

3.6 Relationship With Prior Data Release

Pivot tables for study years 2002-04, 2004-05, 2005-07 and 2007-09 were uploaded into the SOA website as the reports for these voluntary studies were finalized. Pivot tables covering mandatory study years 2009-12 were uploaded last year. This new set of pivot tables covering observation years 2003 to 2013 combines the voluntary studies with the mandatory studies.

3.7 Age Determination

In both the pivot tables and CSV files, age is on an Age Nearest or Age Last basis, as provided by the carrier. There has not been a separate calculation to calibrate all the ages to an Age Nearest or Age Last basis.

3.8 Data Fields

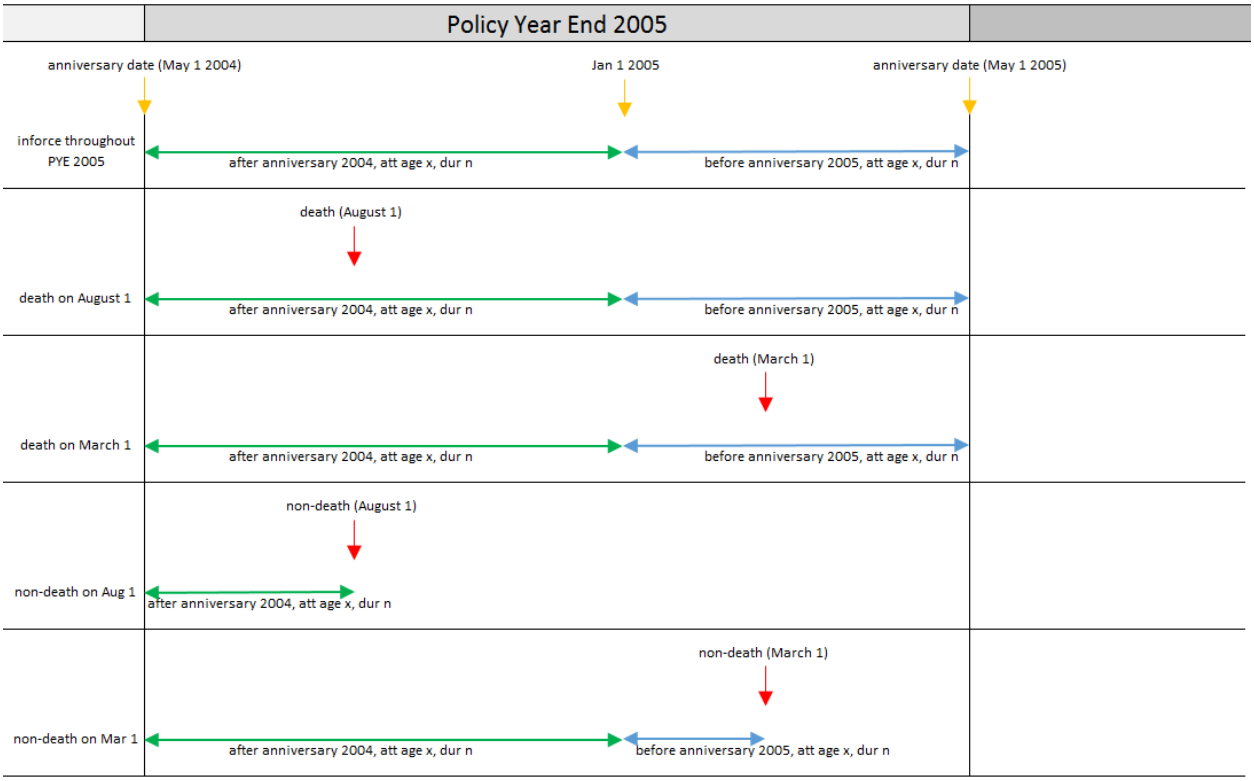
Appendix 1 Contains a list of all fields available in the data. The information shown on the pivot tables is summarized from the main CSV files. For this reason, the data fields include a description of the range of the data included in the CSV files, and a description of the range and summarized version of the field available in the pivot tables.

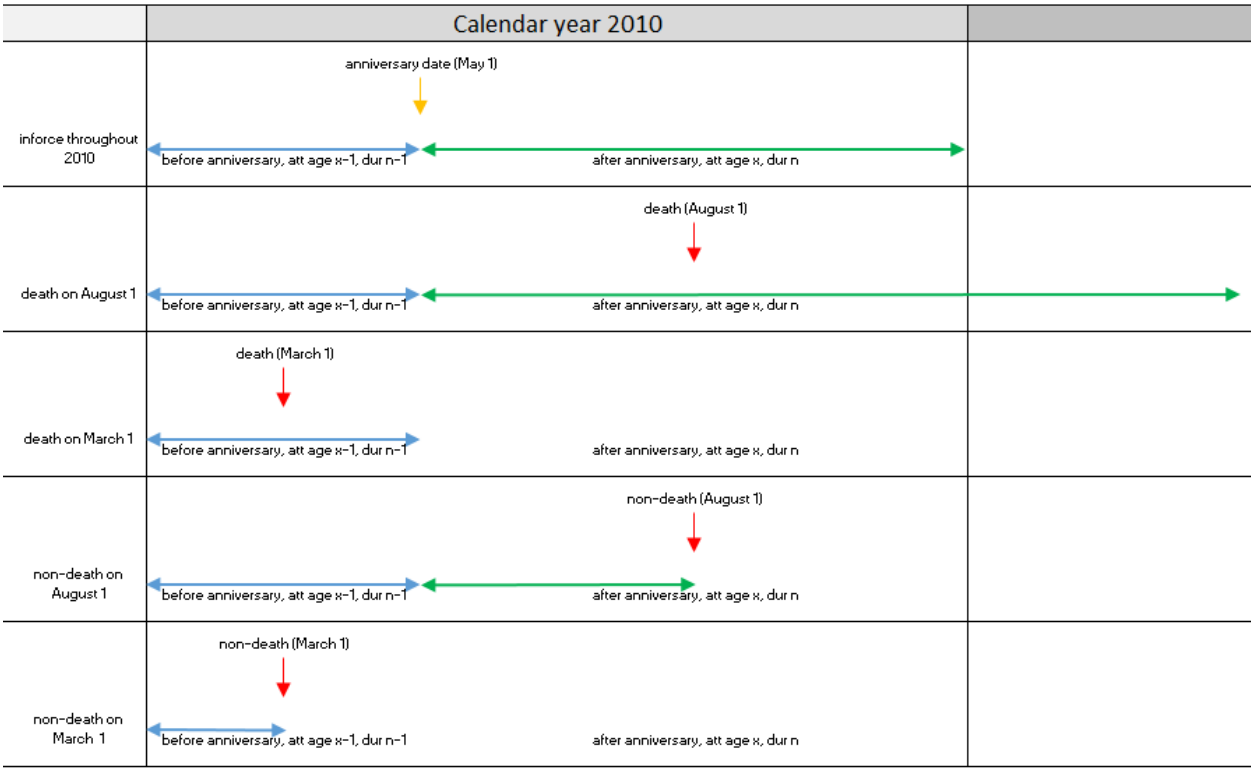
Section 4: Assumptions and Methodology

4.1 Balducci Method

The Balducci Method of exposure calculation was used in both the ILEC and mandatory studies. In this method, upon death, the exposure continues on to the next policy anniversary even if the calendar year has ended or even if the end of the study has been reached. For non-deaths, the exposure ends at the date of termination.

The following are diagrams of this method for policy year 2005 and observation year 2010. The assumed anniversary date is May 1st The blue arrow represents the exposure before anniversary (from January 1 to May 1 or to non-death termination date). The green arrow represents the exposure after anniversary (from May 1 to January 1 or to the next anniversary date or non-death termination date). A missing arrow means the exposure is zero for that segment.





In the second case for calendar year 2010 above, where the exposure after anniversary crosses over to calendar year 2011, this case is no longer inforce in calendar year 2011 so it will not show up for that year.

4.2 Data Prior to 1980

The data that was collected for years prior to 1980 did not include the same categorizations for smoker and preferred statuses. Hence any use of this data that includes exposures and deaths for years prior to 1980 may not be consistent with the data for years after 1980.

There was no distinction between nonsmokers and smokers before 1980. Records submitted with issue years before 1980 were set to the unknown smoker status. Companies generally started distinguishing between nonsmokers and smokers in 1980.

Similarly for preferreds, companies generally started issuing preferred policies in 1980. Policies with issue years before 1980 had their preferred indicators set to 0.

4.3 Juveniles

For this study, we considered issue ages or attained ages below 18 as the juvenile ages. As for the smoking status of juveniles, although we encountered juvenile records which labeled as smokers, we set the smoker status of juveniles to unknown.

4.4 Base Policy Approach

In the LSS submission, the companies gave us information on the base policy separately from the riders. The base policy approach consists of enforcing the base policy's issue age, duration, smoking status, insurance plan and risk class on the rider(s).

Expected Mortality Tables

These are the expected mortality rates being used in the study (for each combination of male/female, select/ultimate, nonsmoker/smoker/unknown, ANB/ALB, if available):

1. SOA 1975-80
2. 2001 VBT
3. 2008 VBT Primary Table
4. 2008 VBT Limited Underwriting Table
5. 2015 VBT

4.5 Preferred Class Structures

We differentiate preferred class structures (PCS) by the number of classes in the structure. A PCS of 2 means policies were classified as either in the preferred or standard class. A PCS of 3 has policies classified as super preferred, preferred or standard. A PCS of 4 has classes best preferred, mid preferred, preferred or standard. Companies referred to the preferred classes differently. Some used the term super preferred, preferred plus and so on.

For some PCS 5 in the ILEC 2003-09 submissions, upon analysis, there were only remaining in force records in classes 1, 3 and 5. We found it strange that it did not have remaining in force records in classes 2 and 4 so we reclassified this as a PCS 3 with class 1, 2 and 3 (the 3 changed to 2 and the 5 changed to 3).

In our analysis of the PCS in LSS 2009-13, we found that PCS 2 to 4 were common for nonsmokers and a PCS of 2 for smokers. Very few companies deviated from these. Some had a PCS of 5 and even 6 for nonsmokers. To maintain confidentiality though, we excluded records with PCS of 5 and 6 in the preferred analysis. They were in the aggregate analysis except that they were classified as not preferred.

4.6 Calculations and Summations

Exposures by policy and amount, and expected mortalities by policy and amount are calculated per record.

General formula for exposures:
Policy Exposed = (number of days in BA segment / number of days in the policy year the BA segment is in)
+ (number of days in AA segment / number of days in the policy year the AA segment is in)
Amount Exposed = Policy Exposed * Insurance Amount

For the ILEC studies, the insurance amount is the face amount submitted. For the LSS submissions, the insurance amount is either, if available, the face amount at issue, the face amount at the beginning of the year for the before anniversary segment, the face amount at the end of the year for the after anniversary segment, or the claim amount.

Using the corresponding expected mortality rate for each of the expected mortality tables:
Expected Mortality by Policy = Expected Mortality Rate * Policy Exposed
Expected Mortality by Amount = Expected Mortality Rate * Amount Exposed

These are then summed, as well as the deaths and amount of claims, for use in a pivot table. The actual to expected (A/E) mortality ratios are then calculated for every combination of categories or filters in the pivot table.

A/E Ratio by Policy = Total Number of Deaths / Expected Mortality by Policy
A/E Ratio by Amount = Total Amount of Claims / Expected Mortality by Amount

Please refer to Appendix 1 for the description of the other fields or data elements used in the pivot table.

Section 5: Pivot Tables and CSV Files

5.1 Description of Pivot Tables

There are 4 pivot tables for this study covering observation years 2003 to 2013. Please refer to Appendix 1 for information on the data elements contained in the pivot tables.

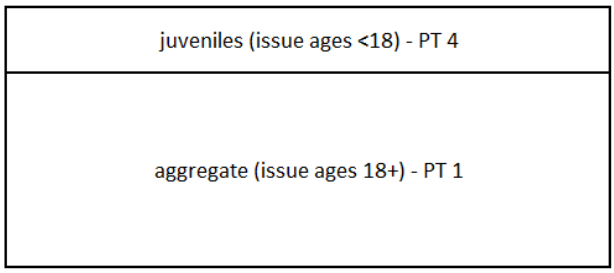
Pivot Table 1: "2003-13 Aggregate 18+ 2017-XX-XX.xlsx" – Contains information/results for records with issue ages 18 and higher. Because of Excel limitations, there is no preferred risk class information here nor information on the anticipated or guaranteed level term period.

Pivot Table 2: "2003-13 Preferred 18+ 2017-XX-XX.xlsx" – Contains information/results for records with issue ages 18 and higher that were classified under a preferred class structure. There is also no information here on a record's anticipated or guaranteed level term period. Pivot Table 1 has a preferred indicator that if you set it to '1', it should match the information in this pivot table except that it does not have detailed preferred class information.

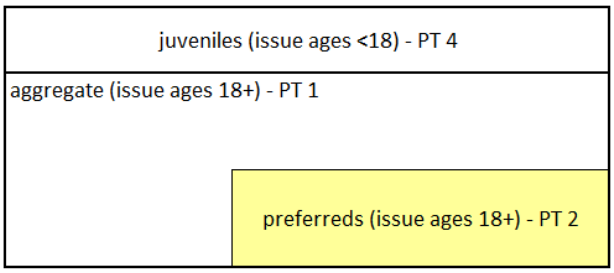
Pivot Table 3: "2003-13 Term 18+ 2017-XX-XX.xlsx" – Contains information/results for records with issue ages 18 and higher but for term insurance plans only. This has information on a record's anticipated or guaranteed level term period. If you set the Insurance Plan to "Term" in Pivot Table 1, it should match the information in this pivot table.

Pivot Table 4: "2003-13 Juveniles Smoker Unknown 2017-XX-XX.xlsx" – Contains information/results for records with issue ages below 18. Only a few companies issued preferred policies for juveniles so to maintain confidentiality, we removed preferred class information for this file.

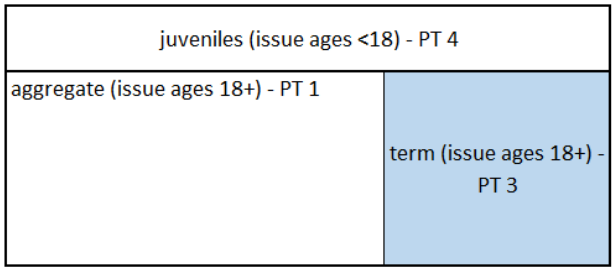
Tables 1 and 4 are the universe of policies/records in this 2003-13 study. Pivot Table 2 and 3 policies/records are in Pivot Table 1. Some of the policies/records in Pivot Table 3 are also in Pivot Table 2. The following is a diagram that shows these relationships.



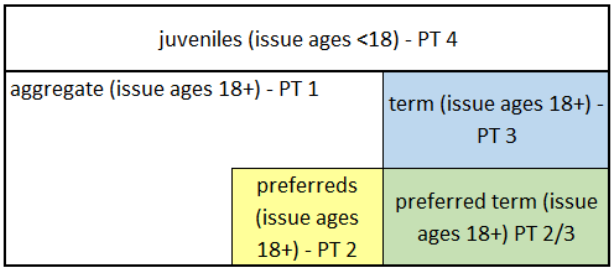
Files 1 and 4



Files 1, 2 and 4



Files 1, 3 and 4



Files 1, 2, 3 and 4

To accommodate requests for files that can be used for predictive analytics, the ILEC is also releasing CSV files of the pivot tables. In these CSV files, nothing is grouped except for the face amount band. That is, individual issue age, duration, attained age and issue year information can be found in the CSV file. These fields had to be grouped for the pivot tables to avoid size limitations in Excel.

CSV File 1: "CSV 2003-13 Adults 2017-XX-XX.csv" - Contains information/results for records with issue ages 18 and higher. There are no size limitations for CSV files so there is preferred risk class information here and information on the anticipated or guaranteed level term periods for this CSV file. This is the same data as in Pivot Table 1.

CSV File 2: "CSV 2003-13 Juvenile Smoker Unknown 2017-XX-XX.csv" - Contains information/results for records for issue ages below 18. There is information on anticipated or guaranteed level term periods for this CSV file. This is the same data as in Pivot Table 4.

5.2 Summary of Results

Here is a summary of the results for each of the Pivot Tables for the ILEC PYE 2003-09, LSS CY 2009-13 and the combined ILEC 2003-13:

	Aggregate - PT 1	Preferred - PT 2	Term - PT 3	Juveniles - PT 4
ILEC PYE 2003-2009				
Number of Deaths	2,366,551	122,259	316,991	193,226
Death Claim Amount	$63,227,930,608	$20,149,152,635	$19,371,197,882	$957,466,616
Policies Exposed	206,851,230	55,730,804	72,652,881	58,724,416
Amount Exposed	$29,221,747,998,764	$16,124,566,401,775	$18,626,957,561,858	$1,480,546,956,849
A/E Ratio 2015VBT by Amount	109.9%	109.0%	112.8%	113.5%
A/E Ratio 2015VBT by Policy	117.9%	124.5%	131.6%	111.7%
LSS CY 2009-2013				
Number of Deaths	2,216,661	198,076	141,491	188,714
Death Claim Amount	$110,092,751,090	$57,427,712,244	$32,560,774,333	$1,489,325,024
Policies Exposed	196,016,648	88,706,947	80,530,616	53,043,440
Amount Exposed	$44,512,619,377,030	$35,615,945,987,462	$32,148,148,806,379	$1,760,547,058,282
A/E Ratio 2015VBT by Amount	95.9%	91.6%	90.0%	104.1%
A/E Ratio 2015VBT by Policy	107.2%	107.0%	109.7%	94.1%
ILEC 2003-2013				
Number of Deaths	4,498,123	316,294	456,890	374,503
Death Claim Amount	$171,191,973,478	$76,959,326,491	$51,463,929,024	$2,410,601,003
Policies Exposed	395,673,211	143,230,446	151,226,938	109,421,427
Amount Exposed	$72,433,350,866,956	$51,316,061,862,891	$49,880,434,049,374	$3,173,314,973,970
A/E Ratio 2015VBT by Amount	100.9%	95.5%	97.7%	108.0%
A/E Ratio 2015VBT by Policy	112.7%	113.0%	124.3%	102.2%

	Aggregate - PT 1	Preferred - PT 2	Term - PT 3	Juveniles - PT 4
ILEC PYE 2003-2009				
Death Claim Amount	$63,227,930,608	$20,149,152,635	$19,371,197,882	$957,466,616
Number of Deaths	2,366,551	122,259	316,991	193,226
Amount Exposed	$29,221,747,998,764	$16,124,566,401,775	$18,626,957,561,858	$1,480,546,956,849
Policies Exposed	206,851,230	55,730,804	72,652,881	58,724,416
A/E Ratio 2015VBT by Amount	109.9%	109.0%	112.8%	113.5%
A/E Ratio 2015VBT by Policy	117.9%	124.5%	131.6%	111.7%
LSS CY 2009-2013				
Death Claim Amount	$109,492,184,327	$57,365,324,976	$32,560,774,333	$1,459,878,030
Number of Deaths	2,146,509	197,046	141,491	180,444
Amount Exposed	$44,413,750,913,553	$35,592,793,947,641	$32,148,148,806,379	$1,723,602,512,117
Policies Exposed	191,274,311	88,510,930	80,530,616	48,694,595
A/E Ratio 2015VBT by Amount	96.1%	91.6%	90.0%	105.9%
A/E Ratio 2015VBT by Policy	108.9%	107.1%	109.7%	99.7%
ILEC 2003-2013				
Death Claim Amount	$170,591,406,715	$76,896,939,223	$51,463,929,024	$2,381,154,009
Number of Deaths	4,427,971	315,264	456,890	366,233
Amount Exposed	$72,334,482,403,481	$51,292,909,823,071	$49,880,434,049,374	$3,136,370,427,805
Policies Exposed	390,930,874	143,034,429	151,226,938	105,072,582
A/E Ratio 2015VBT by Amount	101.0%	95.5%	97.7%	109.2%
A/E Ratio 2015VBT by Policy	113.7%	113.1%	124.3%	105.6%

Please note that ILEC PYE 2003-2009 and LSS CY 2009-2013 overlap so these two do not sum up to ILEC 2003-2013.

Section 6: Reliance and Limitations

A section on Reliance and Limitations is recommended. Can include any limitations on uses and distribution of the report.

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.

The ILEC is responsible for the assumptions that have been made regarding the calculations that are part of these tables. Significant experience is needed to use and interpret the results derived from these tables - users of this table should ensure that they have required expertise to fully understand any results that depend on these tables.

Appendix 1: List of Data Elements

Please refer to the spreadsheet "APPENDIX 1. LIST OF DATA ELEMENTS".

About The Society of Actuaries

The Society of Actuaries (SOA), formed in 1949, is one of the largest actuarial professional organizations in the world dedicated to serving 24,000 actuarial members and the public in the United States, Canada and worldwide. In line with the SOA Vision Statement, actuaries act as business leaders who develop and use mathematical models to measure and manage risk in support of financial security for individuals, organizations and the public.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement, and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

Quality: The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and non-actuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

Relevance: The SOA provides timely research on public policy issues. Our research advances actuarial knowledge while providing critical insights on key policy issues, and thereby provides value to stakeholders and decision makers.

Quantification: The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

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