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Aging and Retirement

Measuring Long-Term Care Insurance Incidence Rates Over Time

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CONTENTS

Section 1: Executive Summary

There are multiple ways to analyze long-term care (LTC) insurance experience to determine if calendar-year trends exist. This report describes two methods, an observation-based analysis and an actual-to-model analysis. However, other types of analysis to determine if changes in historical experience exist, other than those driven by the mix of business, are acceptable.

The main purpose of the report is to provide examples of two methods to study incidence trends and describe some factors to consider when performing such analysis.

This report provides methods of analysis, with actual data, to measure historical changes in experience. This report does not provide actuarial justification for any morbidity improvement assumptions, including positive, negative, or neutral future expectations. Each method is performed using total lives incidence rates. A similar analysis was conducted on an active lives basis and did not yield materially different results.

Method 1 is the observation-based analysis. In this analysis, the number of factors required to determine a homogeneous experience group is critical. The number and type of variables included in this analysis is a critical question and may have a material impact on trends over time. In addition, the credibility of any observable pattern is a critical component, given the changing profile of the LTC industry. Additional control variables increase homogeneity of the data subset being analyzed. However, further stratification of the data creates fewer claims to observe and reduces the credibility of observable trends.

Method 2 is the actual-to-model analysis. This method's use of a model increases the number of cells in the dataset that can be jointly evaluated. Method 2 is reliant on the selection of a base set of assumptions. In this analysis, the patterns by policy duration and attained age suggest there have been changes in experience over time.

In the case of either method, the declining or increasing incidence rates cannot and should not be considered conclusive evidence of morbidity improvement or deterioration, respectively. Calendar year trends could be attributed to any number of factors, including, but not limited to, lack of homogenous data, underwriting changes, changing health status, and product changes. External impacts such as the economic environment or rate increases on a policy may affect incidence rate patterns by calendar year. Each method contains uncertainty for various reasons and the reader's conclusions should be carefully weighed with all the information provided.

Additional data collection around product and underwriting changes may be captured in the future and may be a consideration for future SOA Intercompany LTC Experience Studies. Future intercompany experience studies may be designed to facilitate the review and measurement of calendar-year trends.

It is important to note that the presence of historical improvement or deterioration does not necessarily indicate that patterns will continue in the future. Actuarial assumption development for future calendar-year trends is like other actuarial assumptions. It should be considered with the use of many data points and sources. Considerations for additional data include, but not limited to, company experience, population experience, and medical research assists in the development of actuarial assumptions.

Section 2: Background and Scope

2.1 Background

An initiative emanating from the June 2018 Society of Actuaries Board of Directors meeting was created to provide additional education and research for actuaries working within the long-term care insurance product line. One of the recommendations was to analyze morbidity experience to evaluate if calendar-year changes were observable in the long-term care insurance experience data.

Morbidity improvement is traditionally defined by long-term care actuaries as reductions in future benefit payments, because of medical advancements and general improvements in health and lifestyle, over time as compared to historical levels. New claim incidence rates are the focus of this report. As an example, if all other characteristics are equivalent, the future incidence rates for a cohort will be lower than suggested by historical experience. From an actuarial modeling perspective, calendar-year adjustments reduce the number of anticipated future new claims from the base assumption. Historical experience may be used to determine the base assumption.

This report explores two ways to analyze a dataset for measuring historical changes in claim incidence rate. Other methods may exist that would be appropriate as well. Although similar methods could be used to analyze other aspects of morbidity, such as claim continuance (lengths of stay) or benefit utilization (benefits used relative to benefits available), this study does not evaluate those aspects to provide a full view of changes in morbidity.

The report examines the data in the 2000-2011 Intercompany Long-term Care Experience Study[1] ("Aggregate Databases"). This dataset is actual experience data submitted by long-term care insurers for the purpose of this Society of Actuaries' study. Given the limitations of the publicly available Aggregate Database described in Section 2.6, this study analyzes the ungrouped dataset.

This report should be reviewed in its entirety and does not replace the actuarial judgment required for the development of long-term care insurance actuarial assumptions.

2.2 Project Oversight Group

The Society of Actuaries would like to thank the Project Oversight Group ("POG") for their support, guidance, direction, and feedback throughout the project.

Members of the POG and Society of Actuaries staff members are shown below:

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Janet Perrie, FSA, MAAA

[1] https://www.soa.org/experience-studies/2015/research-ltc-study-2000-11-aggregrated/

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SOA Staff support:
Cynthia MacDonald, FSA, MAAA, CFA
Mervyn Kopinsky, FSA, EA
Pete J. Miller, ASA, MAAA
Erika Schulty

2.3 Scope

The scope of this project has been limited to analyzing calendar-year trends in long-term care insurance incidence rates. An overall morbidity trend study would also consider calendar changes to claim length or benefit utilization, but these morbidity components are not discussed in this report. As such, the statements included in this report related to changes in claim incidence rates by calendar year are limited.

This report analyzes aggregate incidence rates, without consideration for shifts in site of care. This analysis does not consider changes in the mix of claim diagnoses that may be in the actual experience. The diagnosis associated with each claim is not included in the dataset. In addition, there is concern regarding the consistency of coding diagnosis data across the industry.

This report and examination illustrate two types of analysis to determine if there have been changes to incidence rates by the calendar year in which the claim occurred. This report is not an exhaustive list of methods for reviewing calendar-year incidence trends.

2.4 Description of Method 1 – Observation

Method 1 uses actual experience and observed changes by calendar year within a given homogeneous insured population. There are many variables to control for consistency across periods of time. This report illustrates the tradeoff between increasing the number of variables for the cohort, and the resulting reduction in the number of observable claims, and discusses the limitations of the conclusions.

A total life incidence rate is used in this report. An analysis was conducted to test whether an active life incidence would yield different results and did not generate materially different trends.

Additional information about this method is discussed in Section 3 of the report.

2.5 Description of Method 2 – Actual to Model

Method 2 uses the application of model assumptions to experience data to determine if there are calendar-year trends over time. In this method, the 2000-2011 Experience Basic Table[2] ("Model") determines an expected number of claims in each calendar year. This report uses a total life incidence rate. Actual results compared to the model determine if incidence rates are changing over time for reasons other than the mix of business.

[2] https://www.soa.org/experience-studies/2015/2000-2011-ltc-experience-basic-table-dev/

A total life incidence rate is used in this report. An analysis was conducted to test whether an active life incidence would yield different results and did not generate materially different trends.

Additional information about this method is discussed in Section 4 of the report.

2.6 Caveats of Observation Data

This analysis uses the actual year of incurred claim and is based on the ungrouped data underlying the Aggregate Databases.

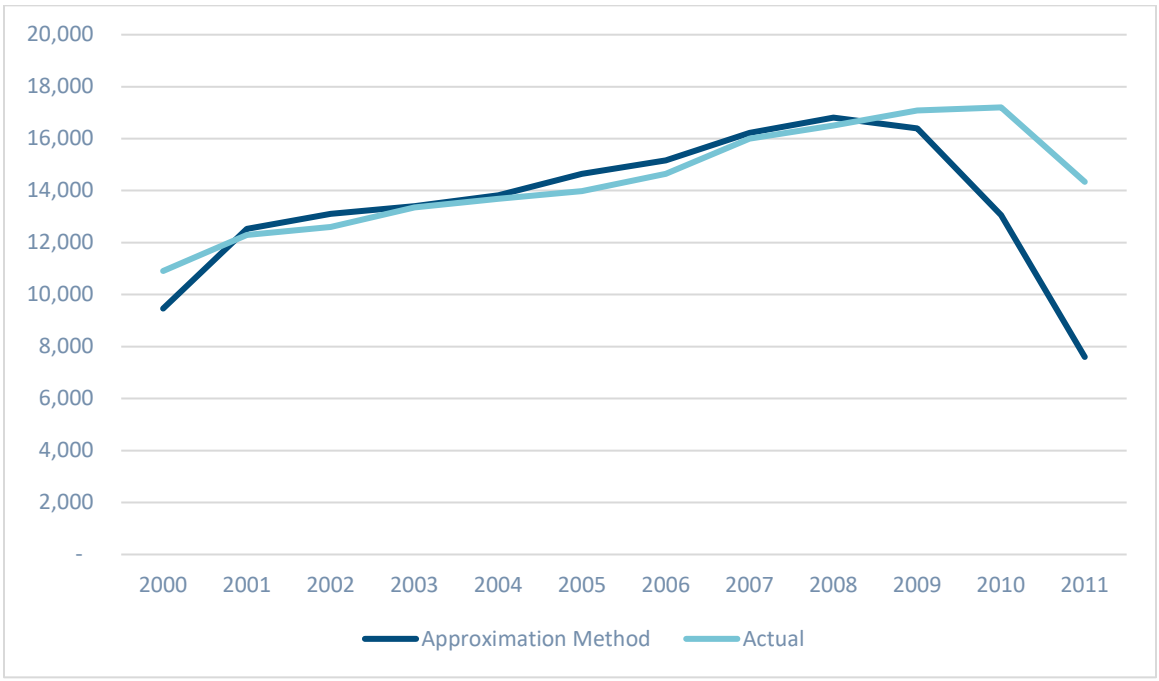
The data in the Aggregate Databases that is publicly available consolidates information to ensure anonymity for those providing data. Calendar year was not included as a variable in the Aggregate Database. In addition, many variables were grouped together, including attained age and issue year. The use of these grouped variables limits the use of the publicly available data for analyzing trends in incidence rates by calendar year.

This report first explores the use of the publicly available data. Calendar-year trend analysis of the publicly available Aggregate Databases requires an approximation of calendar year. One approximation for calendar year that can be used is the following:

- Calendar year approximation =
    - the central point of the issue year range +
    - policy duration - 1

Claim counts by incurred year using the approximation method were then compared to the actual incurred year from the ungrouped underlying data. The observed pattern of each method of counting claims is shown in Figure 2.1.

Figure 2.1
CLAIM COUNT BY CALENDAR YEAR



As shown Figure 2.1, the approximation method pushes more claims to the middle of the experience period and artificially lowers the claims assigned to the endpoint years. Given the need to measure changes over time, this analysis uses the actual calendar year.

The calendar-year approximation described previously should only be used with caution to review changes over time.

The data requested in the original study was intended to be analyzed through December 2011 as of December 2012. The data request's intent was to limit the incurred but not reported (IBNR) claims. However, in our analysis of claims by calendar year, there is a significant dip in new claims in 2011. This is likely incurred but not reported claims. As a result, the analysis in this report excludes experience year 2011.

Section 3: Method 1 - Observation of Actual Experience by Calendar Year

3.1 Description of Method

Method 1 uses actual experience and observed changes by calendar year within a given homogeneous insured population. There are many control variables needed to ensure consistency across periods of time. This report illustrates the tradeoff between increasing the number of variables for the cohort and the resulting reduction in the number of observable claims and discusses limitations of the conclusions.

This method's objective is to remove any inherent biases included in an "expected value" resulting from an assumption derived from a predictive modeling approach, traditional analysis, or industry average.

The probability of a new claim occurrence in long-term care can vary significantly based on a variety of characteristics. These factors include, but are not limited to:

- Attained age
- Gender
- Coverage type
- Policy duration
- Elimination period
- Marital status
- Benefit richness (e.g. pool amount, daily benefit, inflation option)
- Issue age
- Issue year

This section discusses the need to ensure a dataset is homogenous in order to measure calendar-year trends. The number of characteristics controlled for in the analysis is critical to ensuring a homogeneous dataset.

Method 1's goal is to measure the incidence rate experience of homogeneous groups of long-term care data over time on a consistent basis. Observation of actual incidence rates by calendar year allows for the determination of increasing or decreasing trends. A negative slope may indicate improvement, while a positive slope may indicate deterioration in incidence rates, if all key risk characteristics are controlled for in the dataset.

3.2 Control Variables

It is common within the long-term care insurance industry for actuaries to use many variables to estimate future incidence rates. Based on industry knowledge, discussions with the POG, and observations of the data, the following is a list of key variables considered when measuring experience:

- Attained age, ideally a single age, but groupings may be acceptable
- Policy duration, the effect of underwriting selection is clear in early durations
- Marital status
- Gender
- Coverage type
- Elimination period
- Benefit richness
- Type of underwriting
- Tax-qualified status

Additional variables to be considered include, but are not limited to, underwriting class, region, policy form, and benefit triggers. Actuaries should review all available data and consider applicability to their own blocks of business to determine if additional characteristics are required to find consistent cohorts of experience.

3.3 Discussion of Credibility

A key consideration in using this method is the number of observable claims in a given period. It is beyond the scope of this report to determine an appropriate level of credibility. It is important to understand the tradeoff between the number of claims by calendar year and the number of characteristics controlled for in the analysis. With each additional control variable added, the experience data becomes smaller and, thus, less credible.

In each of the charts provided in the report and the appendices, the number of claims is shown for the readers to make their own judgment on the credibility of the dataset, and whether the observed pattern is credible enough to make a conclusion.

The American Academy of Actuaries produced a credibility report related specifically to long-term care in 2016. The Long-Term Care Credibility Monograph[3] provides a significant discussion on credibility and its applicability in long-term care actuarial analysis. The reader is encouraged to read this monograph prior to drawing any conclusions from this report.

An excerpt from the monograph provides the claim count required for several confidence levels and desired accuracies:

Desired Accuracy	Confidence Level		
	90%	95%	99%
+/- 2.5%	4,329	6,146	10,616
+/- 5.0%	1,082	1,537	2,654
+/- 7.5%	481	683	1,180
+/- 10 %	271	384	663
+/- 20 %	68	96	166

This table, along with references to the monograph, provide context for the level of credibility in a given illustration in the report or appendix.

3.4 Sample Results

An extensive set of results is shown in Appendix A. This section describes a sample analysis to observe calendar-year trends of incidence rates.

This example analyzes 85-year-old female incidence rates. The graphs contain several pieces of information. Each graph provides three age bands. The exact age of 85, a three-year grouping, and a five-year grouping are shown for the reader to understand potential limitations of grouped ages. The three age bands are centered around age 85. The illustrations provide claim counts for the reader to determine if there is sufficient credibility to conclude a trend exists. In addition, graphical illustrations present the resulting incidence rate for each calendar year.

[3] http://actuary.org/files/imce/LTC_Credibility_Monograph_08172016.pdf

Note that, if age groupings are being used to represent a given age, one may need to consider the average age within the groupings. If a typical distribution of sales is centered on age 55, then when we look at attained age 85 some years later, there may be an increasing number of 83 and 84-year olds in the grouping over some future periods. If the average age in the "85-year-old" group is going down over the period studied, this could manifest itself as a decreasing incidence rate over time.

A series of steps are shown in Section 3.4. In each step, a drill-down approach is shown, allowing the reader to observe the change in trends with the inclusion of additional characteristics. This example is not intended to be representative of all cohorts, but rather provide an illustration of the analysis. Appendix A shows various groups of data for the reader to analyze.

Step 1: Analyze the incidence rates in aggregate for 85-year-old females. In the graph below, all the data associated with 85-year-old females is shown. No additional variables are controlled for in this experience. For this data selection, there appears to be a downward trend over time. Changes in the underlying mix of coverages are not considered in Step 1 and conclusions should be carefully considered.

Figure 3.1A

ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES BY CALENDAR YEAR

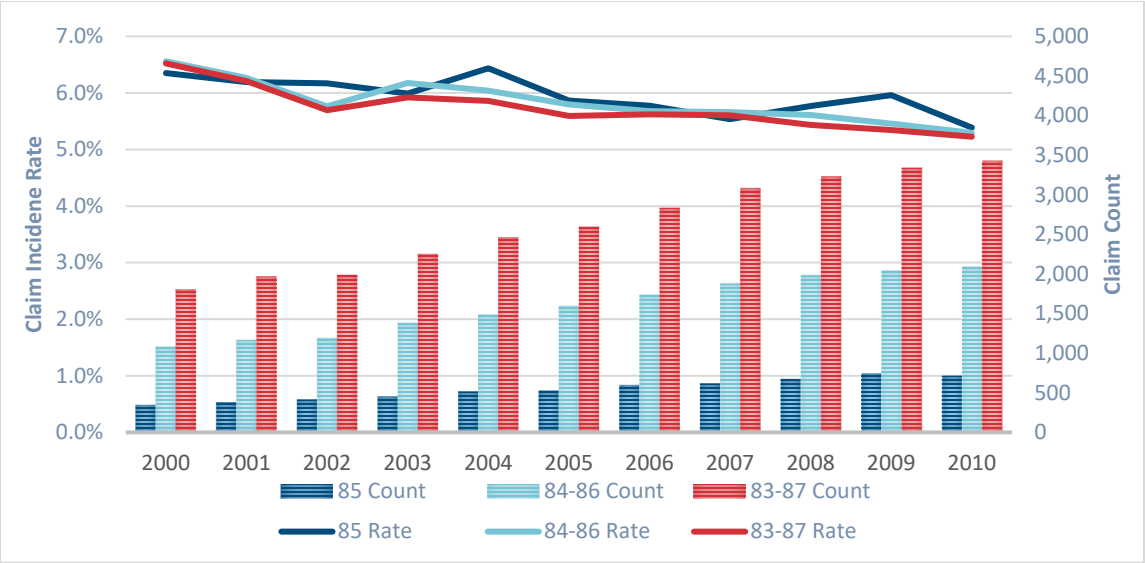
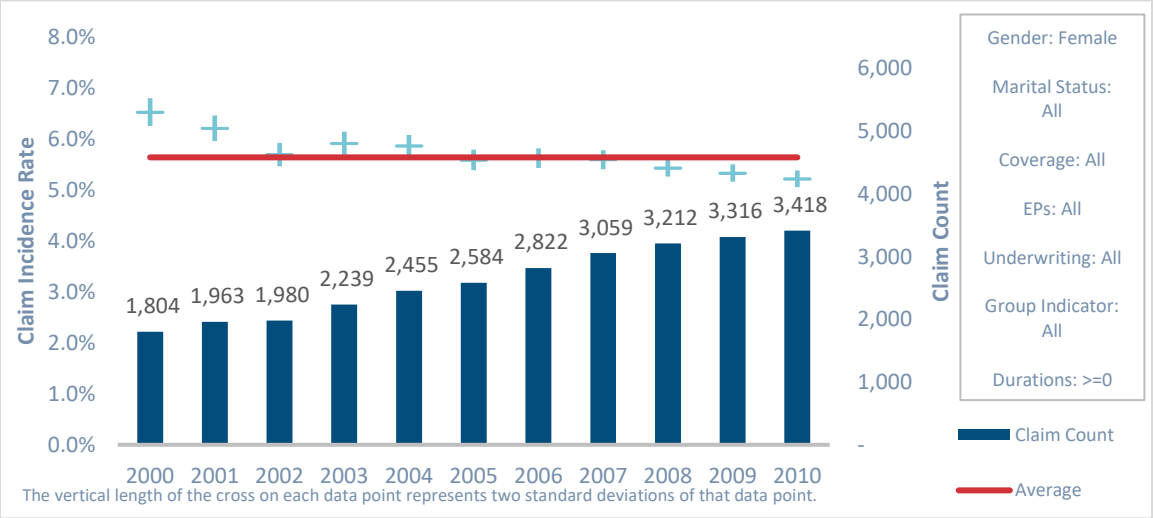


Figure 3.1B presents the same dataset differently. The horizontal red line represents the average incidence rate observed for this data over the entire period. A cross marks the incidence rates by calendar year. The ceiling and floor of the cross represents plus or minus two standard errors of that point based on a binomial distribution. Support for the standard error calculation can be found in the Long-Term Care Credibility Monograph[4]. In Figure 3.1B, a downward calendar-year trend is observed.

Figure 3.1B

ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87



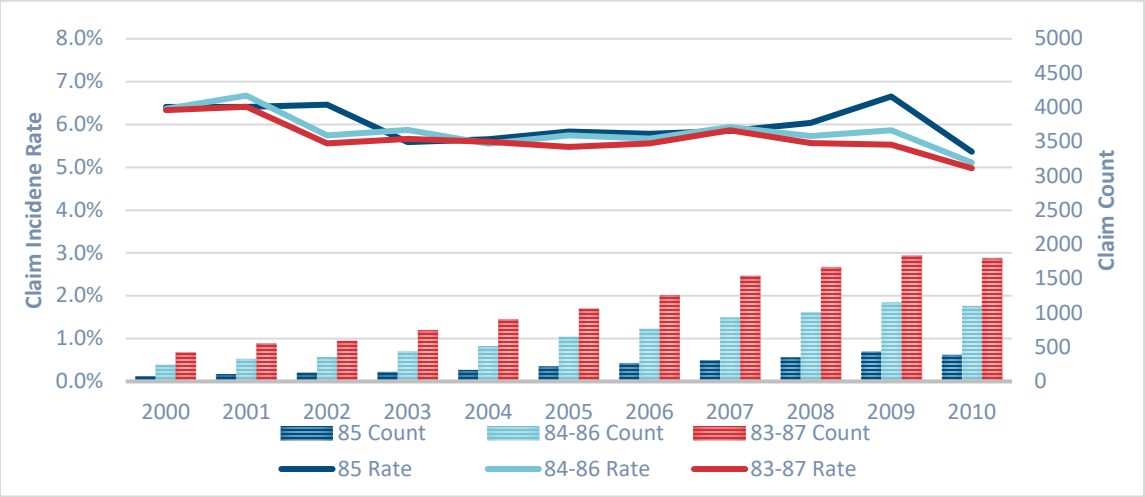
[4] http://actuary.org/files/imce/LTC_Credibility_Monograph_08172016.pdf

Step 2: The experience shown in Step 1 is further split into three types of coverage.

In Figure 3.2A, policyholder experience for 85-year-old females with comprehensive coverage is shown. These policyholders can typically select from nursing homes, assisted living facilities, or care at home at the time of claim. This illustration removes policies with facility-only coverage or home care-only coverage. As shown in the graph, the number of claims becomes limited as it excludes other coverages.

Figure 3.2A

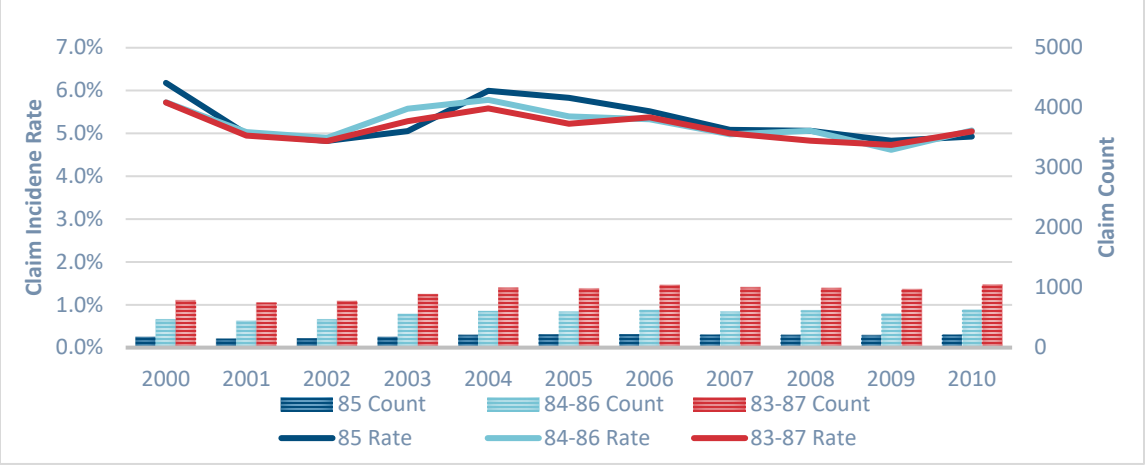
ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES, COMPREHENSIVE COVERAGE BY CALENDAR YEAR



In Figure 3.2B, policyholder experience with nursing home coverage is shown. These policyholders can only receive care in nursing homes to be benefit eligible. This illustration removes policies with comprehensive coverage or home care-only coverage. As shown in Figure 3.2B, the number of claims becomes limited as it excludes other coverages.

Figure 3.2B

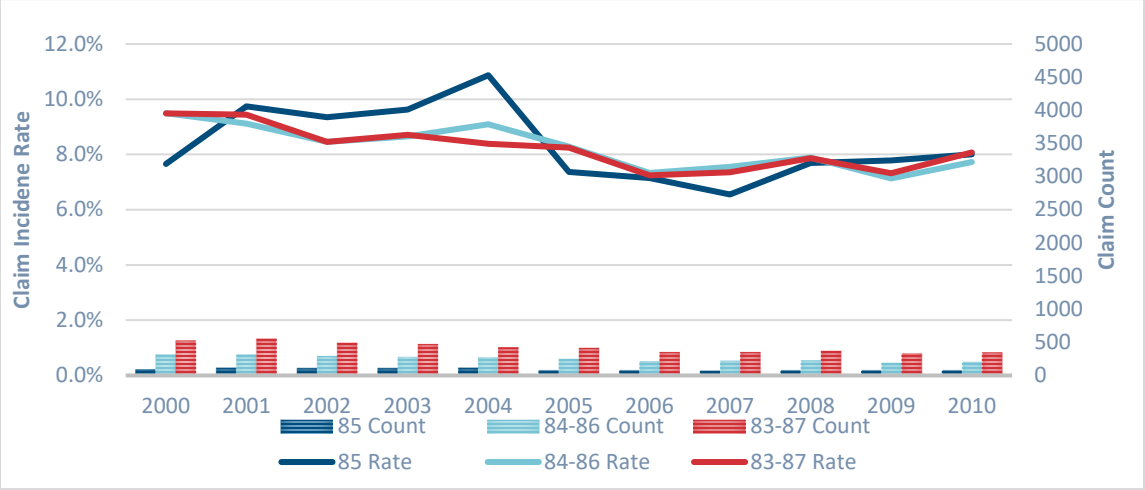
ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES, NURSING HOME COVERAGE BY CALENDAR YEAR



In Figure 3.2C, policyholder experience with home care coverage is shown. These policyholders can only receive care at home to be benefit eligible. This illustration removes policies with comprehensive coverage or nursing home-only coverage. As shown in the graph, the number of claims become limited as it excludes other coverages.

Figure 3.2C

ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES, HOME CARE COVERAGE BY CALENDAR YEAR



In Figure 3.2D, the five-year age bands are shown for each of the coverage types. These coverage types appear to have different incidence-rate levels. Home care-only coverage incidence rates appear to have the highest incidence rates for this age band. Home care-only coverage represents approximately 21% of the exposure in 2000, but declines to only 7% of the exposure in 2010. In contrast, the comprehensive coverage represents 26% of the exposure in 2000 and grows to 59% in 2010. This change in the mix of coverage may cause some of the calendar-year incidence rate downward trend shown in Figure 3.1A, since the highest incidence rate level (home care-only coverage) is a bigger proportion of the data in 2000 than in 2010. The reader should consider the size of these datasets (in Figures 3.2A – 3.2D) relative to those presented in Figure 3.1A.

Figure 3.2D

ANALYSIS OF 83-87-YEAR-OLD INCIDENCE RATES, COVERAGE TYPES BY CALENDAR YEAR

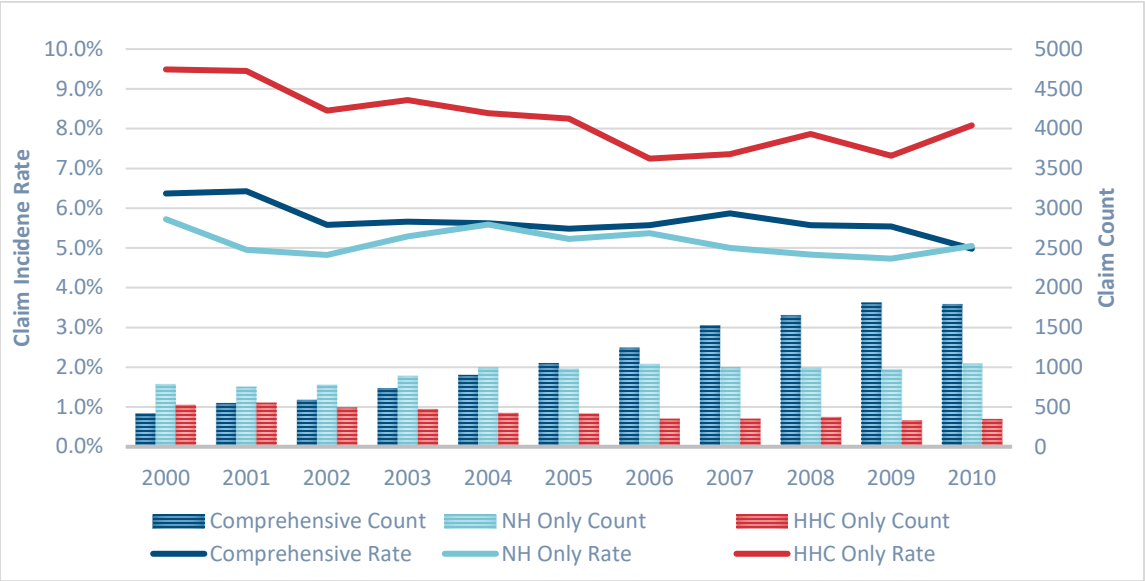


Figure 3.2E for comprehensive coverage only illustrates the changes over time by comparing two standard errors at each point to the average over the entire period. With the additional characteristic included, the downward trend becomes less apparent.

Figure 3.2E

ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87

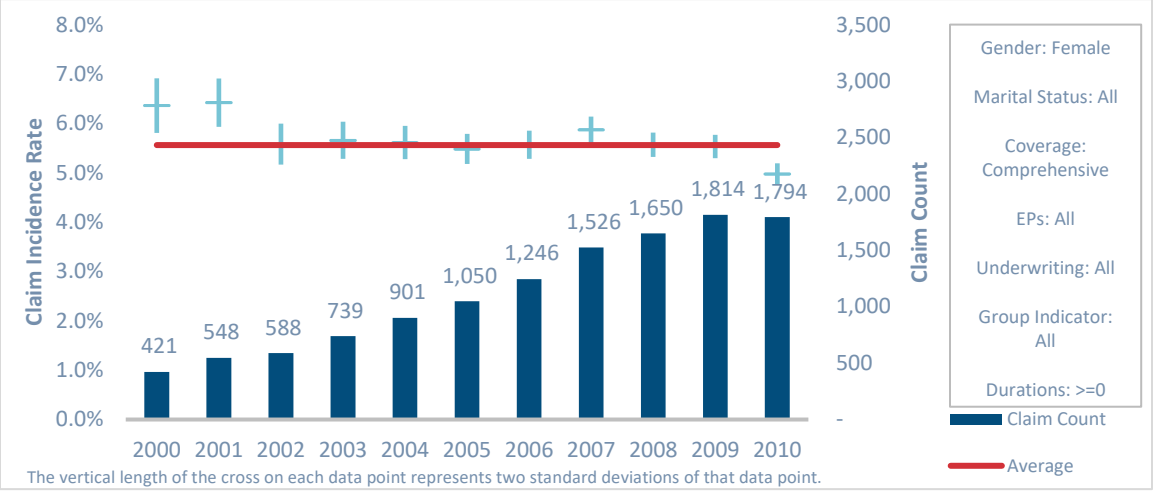


Figure 3.2F for nursing home-only coverage illustrates the changes over time by comparing the standard error at each point to the average over the entire period. With the additional characteristic included, the downward trend becomes less apparent.

Figure 3.2F

ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87

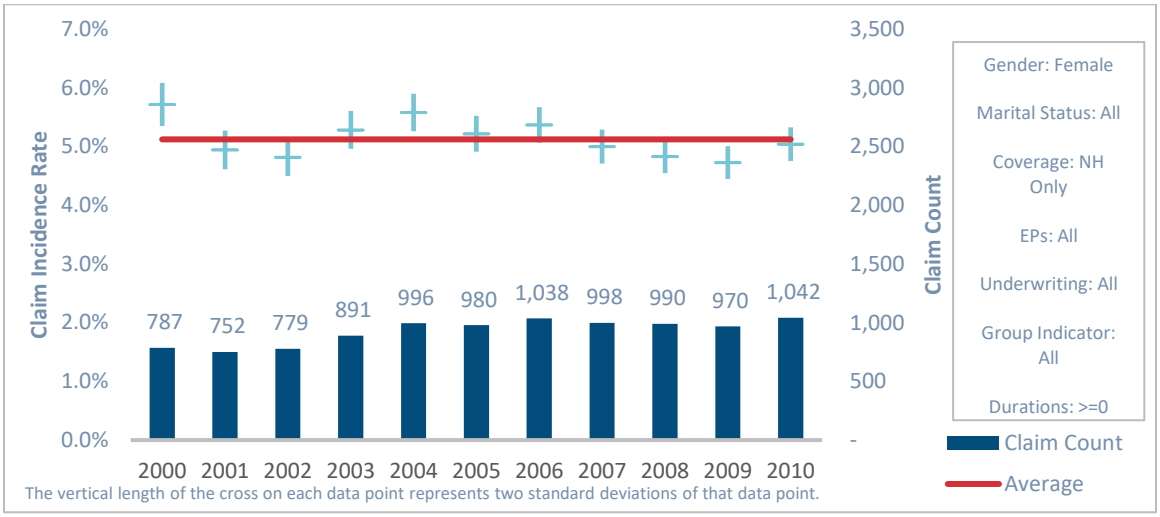
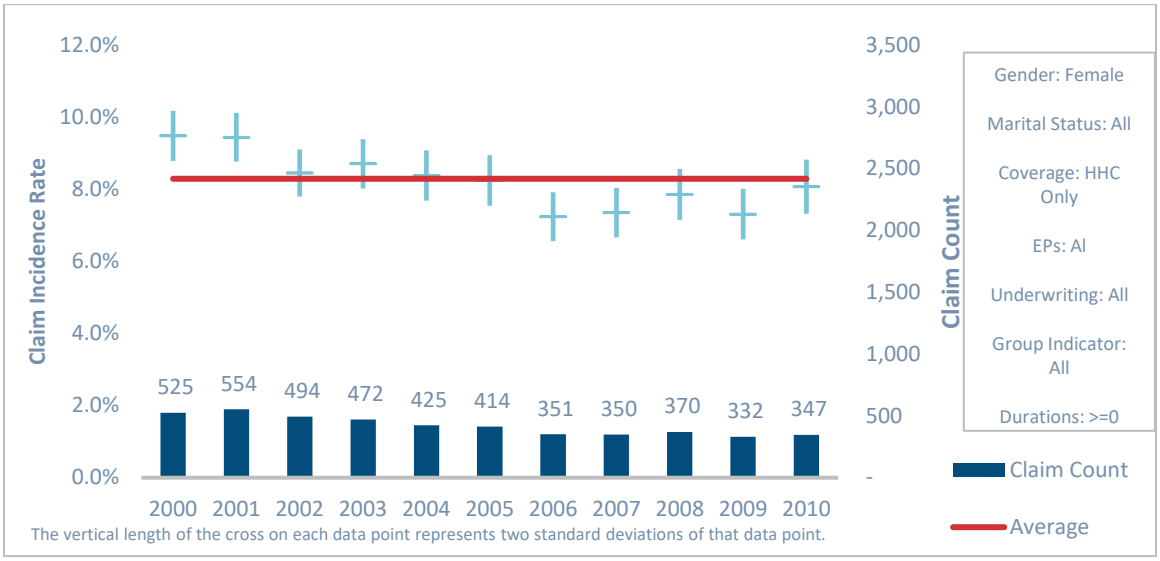


Figure 3.2G for home care-only coverage illustrates the changes over time by comparing two standard errors at each point to the average over the entire period. With the additional characteristic included, the downward trend is still present, but is not as consistent as it was presented in Figure 3.1A.

Figure 3.2G

ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87

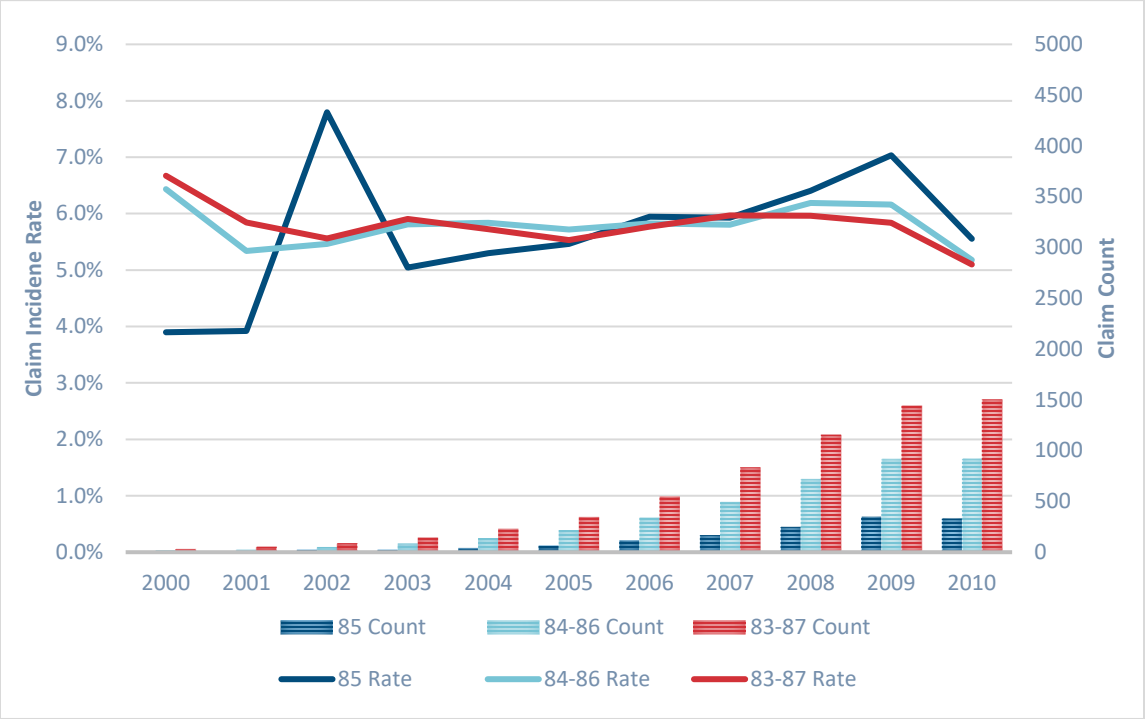


Step 3: Given the growing proportion of comprehensive experience in the dataset and the claim volume, steps 3 through 5 are limited to comprehensive coverage only. The next step increases homogeneity by splitting data for policy duration groupings. Early policy duration experience may be influenced by risk selection and underwriting.

In Figure 3.3A, the first nine policy durations are removed. Please note this is a subjective cutoff for this sample. Different types of underwriting methods, ages, and characteristics may have different appropriate periods. Additional views of the experience are presented in Appendix A.

Figure 3.3A

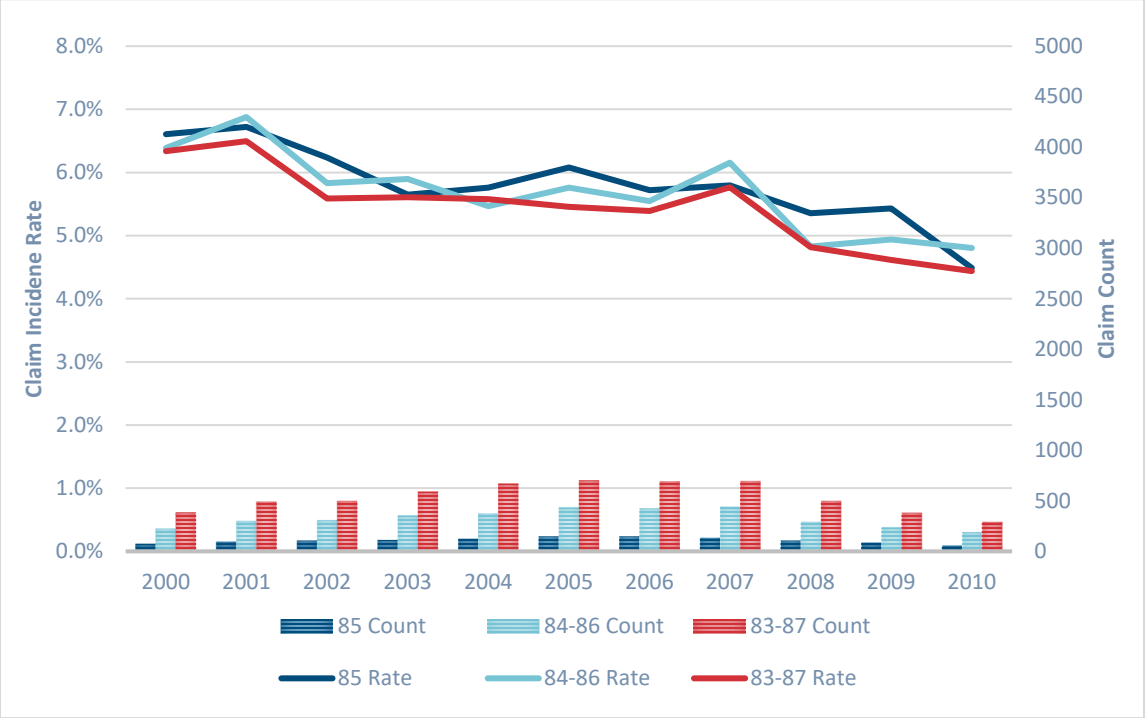
ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES, COMPREHENSIVE COVERAGE
POLICY DURATIONS 10+ BY CALENDAR YEAR



In Figure 3.3B, only the first nine policy durations are shown. Experience in durations 10 and later are removed. This is a subjective cutoff for this sample. Additional views of the experience are presented in Appendix A.

Figure 3.3B

ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES, COMPREHENSIVE COVERAGE
POLICY DURATIONS < 10 BY CALENDAR YEAR

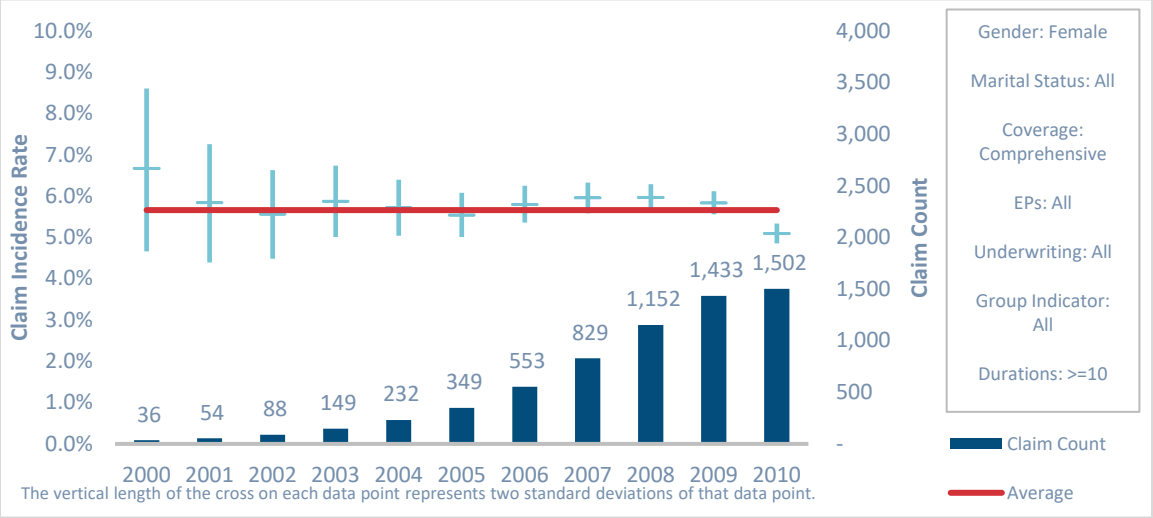


The next two groups attempt to identify calendar trends that may be different by policy duration grouping. Experience in the early calendar years of this report (2000-2002) each have less than 100 observable claims in this data subset. As a result, the standard error expands.

In Figure 3.3C, each data point's experience is within the two standard errors of the overall average, except for 2010.

Figure 3.3C

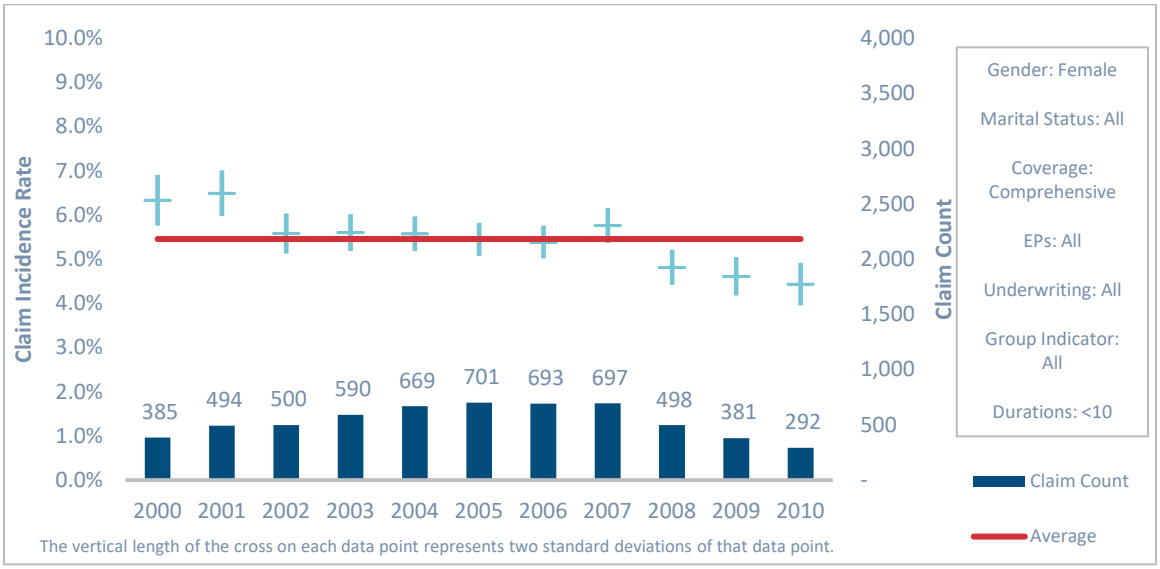
ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87



In Figure 3.3D, it appears a downward trend exists since the first two data points are higher than the overall average by more than two standard errors. The last three data points are lower than the overall average by more than two standard errors.

Figure 3.3D

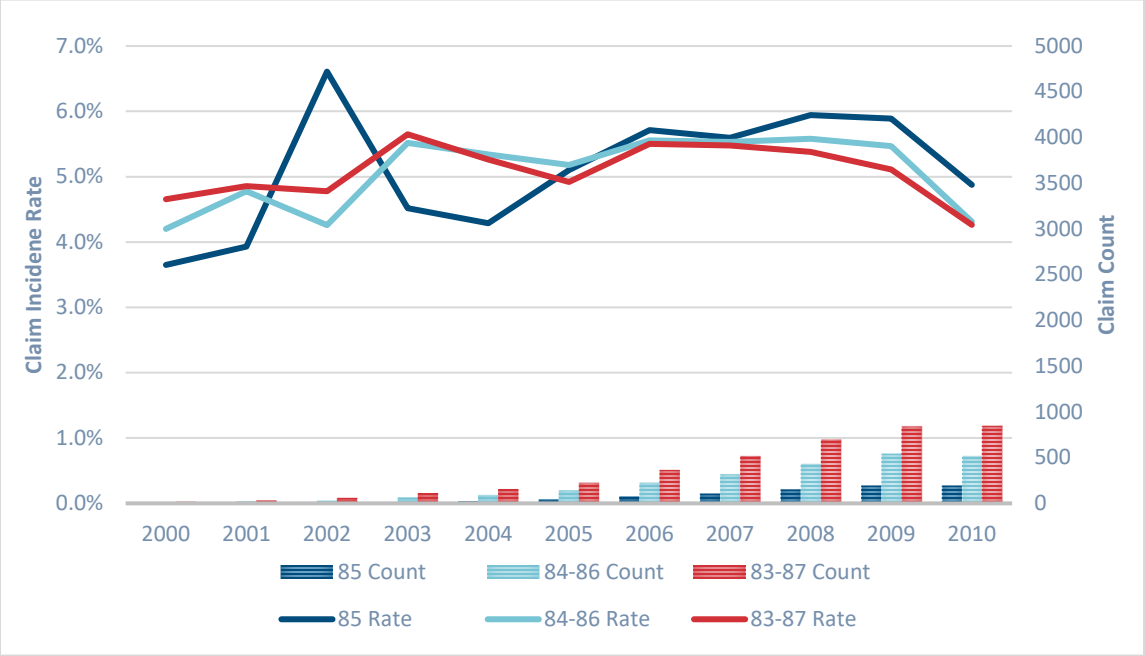
ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87



Step 4: Additional limitations applied to the data include only policies that are individually issued with a full medical underwriting process applied. Figure 3.4A provides further analysis. Claim counts continue to decline with each additional characteristic applied. The reader should consider the credibility of the data when drawing any conclusions from this analysis.

Figure 3.4A

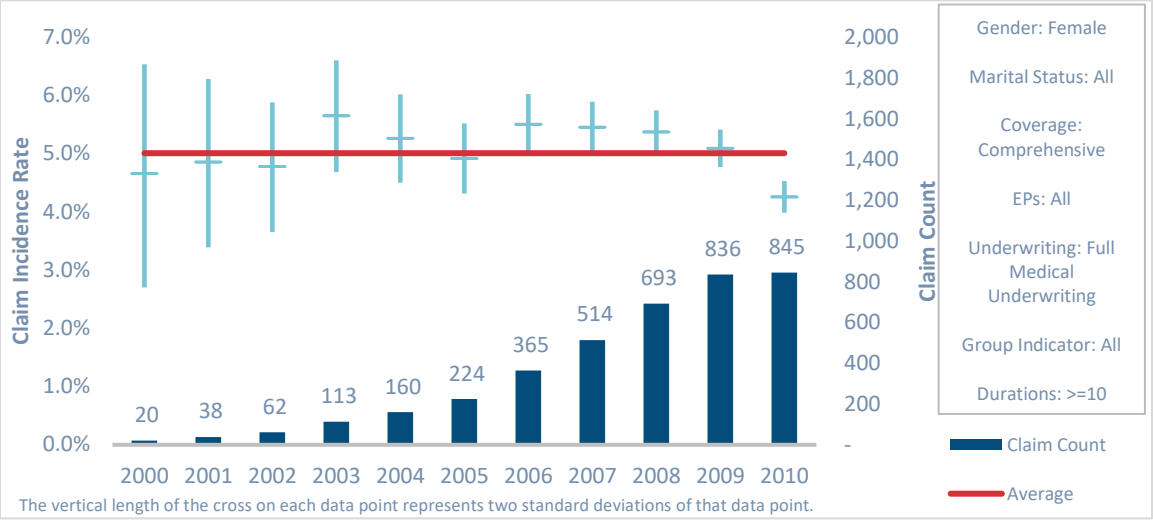
ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES, COMPREHENSIVE COVERAGE; POLICY DURATIONS 10+, INDIVIDUAL; FULLY UNDERWRITTEN



With the inclusion of additional characteristics as filters, the claim data becomes even smaller, with 2000-2005 each having less than 100 claims in a given year. At this level of risk stratification, there is no clear pattern or trend by calendar year as can be shown in Figure 3.4B.

Figure 3.4B

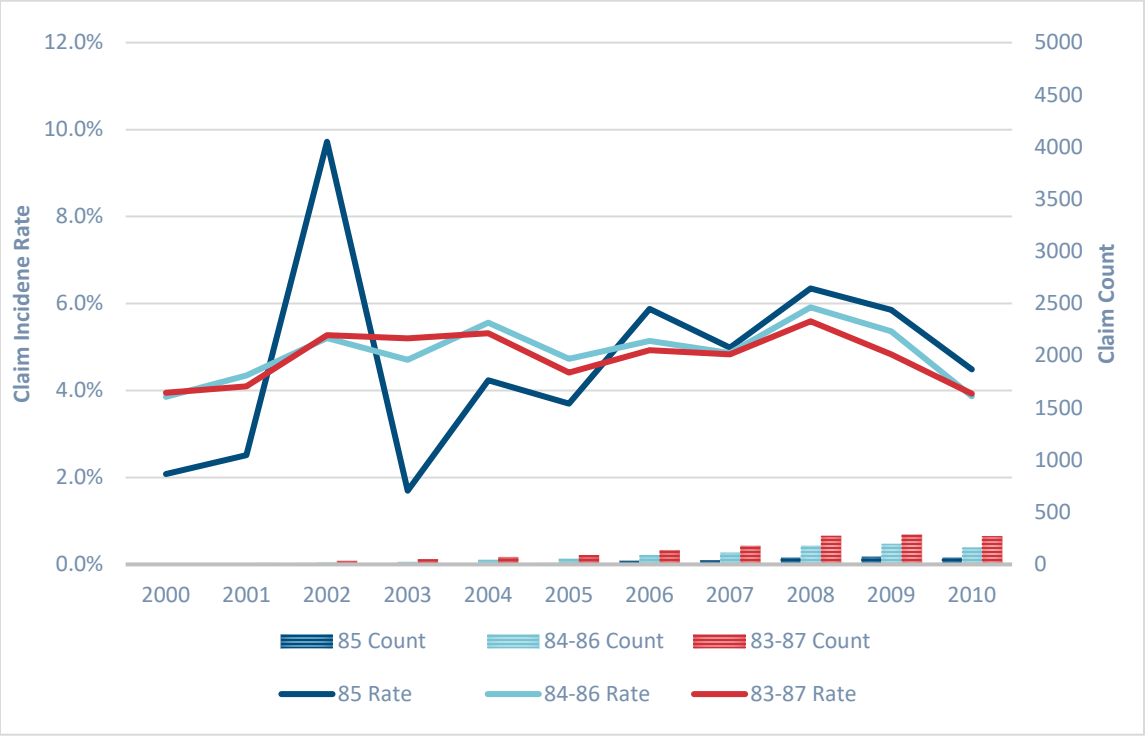
ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87



Step 5: In this step of the illustration, Figure 3.5A includes only policies that were issued as single (marital status) with a 90-day elimination period. These characteristics were selected for illustration since they were most prevalent in the data. This removes married policies and excludes all other elimination periods as each of those cohorts have different incidence rate experience. Claim counts continue to decline with each additional characteristic applied. The reader should carefully consider the credibility of the data when drawing conclusions from this analysis.

Figure 3.5A

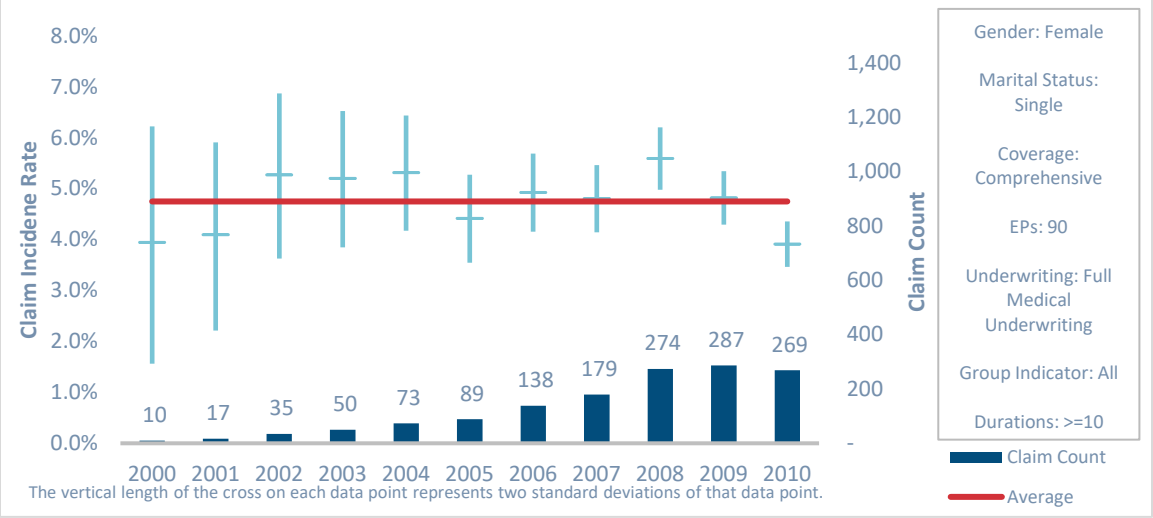
ANALYSIS OF 85-YEAR-OLD INCIDENCE RATES, COMPREHENSIVE COVERAGE; POLICY DURATIONS 10+, INDIVIDUAL; FULLY UNDERWRITTEN; SINGLE; 90 EP



With the inclusion of additional characteristics as filters, the claim data becomes even smaller, with 2000-2005 each having less than 100 claims in a given year. The range of uncertainty is large, especially for the early calendar years. At this level of homogeneous group, there is no clear pattern or trend by calendar year, as shown in Figure 3.5B.

Figure 3.5B

ANALYSIS OF INCIDENCE RATES – AGES FROM 83 TO 87



In conclusion, Step 1 of the illustration indicated a gradual and consistent decline in incidence rates over time for 85-year-old female policyholders without any additional controls placed on the data. In Step 2, the experience is separated by coverage type. From Step 2, its apparent that incidence rates may vary by coverage type and the mix of coverage is changing over time. This step illustrates the importance of controlling variables as shifts in characteristics could appear as trends. In Step 3, policy duration groupings are introduced for comprehensive coverage creating different calendar-year trends. Steps 4 and 5 include additional risk characteristics, and the calendar-year patterns continue to change. As the experience group becomes more homogeneous, a discernable pattern is not clear, which may be partially driven by the low observable claim counts.

As shown in each of the steps 1 through 5, it becomes clear there is a balance between defining a homogeneous cohort and the claim counts observed. The more homogeneous the cohort, the smaller the number of claims over the observed periods of time. The reader's conclusions should be carefully considered with the assistance of statistical credibility.

3.5 Reference to Appendix A with Multiple Variations of Controlled Variables

In Appendix A, a series of homogeneous groups are shown. The reader should consider each of these in isolation and in aggregate when reviewing the report. This appendix limits data groups to those having at least 100 claims over the entire observation period.

Section 4: Method 2 – Actual to Model by Calendar Year

4.1 Description of Method

A key observation after the exploration of Method 1 was the reduction in volume of observed claim counts in each homogeneous cohort. Method 2 bypasses this restriction by controlling for heterogeneity in the dataset. By adjusting the observations pursuant to a model developed to control for variable differences, all policy exposure records can be used. This results in the ability to review calendar-year effects in aggregated datasets.

Given the number of control variables required for incidence rate analysis, this method uses a model that fits by each characteristic without any adjustments for each calendar year. The 2000-2011 LTC Experience Table ("Model") was used and applied to each record. The Model includes factors for the following characteristics:

- Incurred age
- Gender
- Policy duration
- Elimination period
- Coverage
- Marital status
- Underwriting type
- Region
- Maximum daily benefit
- Benefit period
- Tax-qualified status
- Underwriting class

It is also important to note the explicit variables not included in the Model. These variables include:

- Calendar year of incurral
- Policy issue year
- Issue age of policyholder

The authors of the Model considered these variables during construction of the work. However, the generalized linear model overall fit was not materially improved upon inclusion. The model excludes these variables to limit model complexity, prevent collinearity and avoid over-fitting of the model, which are critical considerations in any model development.

The Model applies factors to each exposure record to calculate the expected number of claims associated with each exposure. This analysis measures calendar-year trends for the actual and expected claim count.

It is important to understand and ensure the Model fits by key characteristics before reviewing trends. Trends over time may be driven by mixes of business rather than actual changes in experience if the model does not fit certain characteristics. Figures 4.1, 4.2, and 4.3 provide examples of the actual to Model fit.

It is important to note that, if calendar-year trends exist in Method 2, a significant amount of uncertainty remains as to the cause of these trends. The reader should carefully consider the model selection, credibility of data, homogeneity of the data, and statistical methods employed prior to drawing any conclusions from the following analysis.

Figure 4.1

COMPARISON OF ACTUAL AND MODELED CLAIM COUNTS BY INCURRED AGE

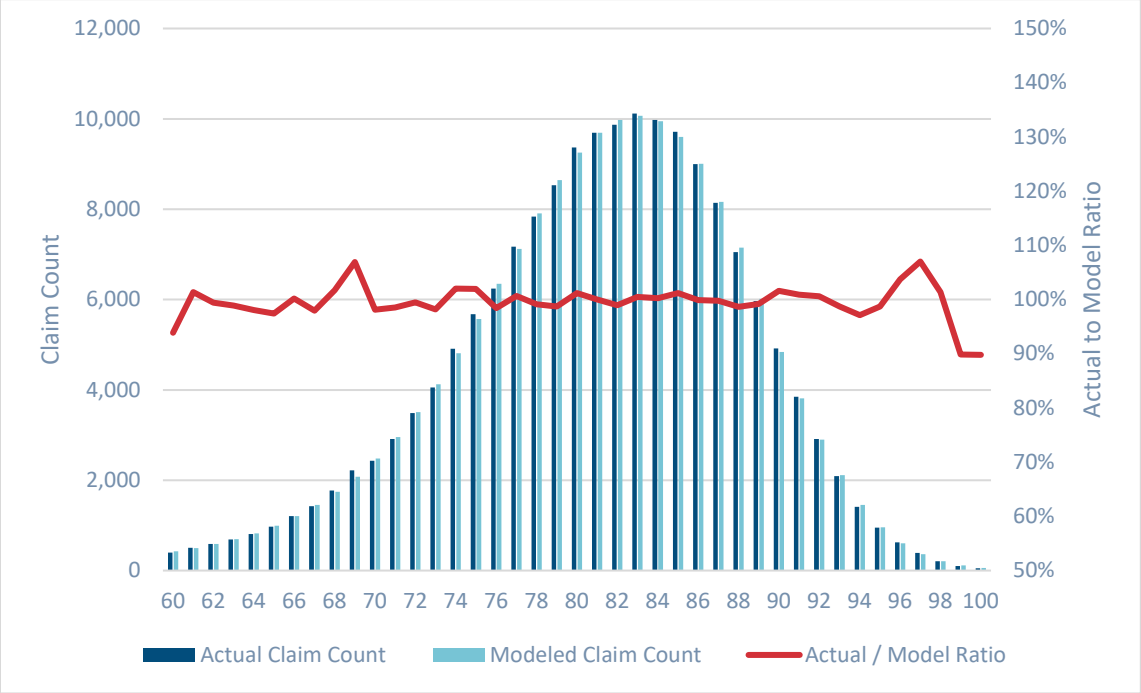


Figure 4.1 illustrates that, in general, the Model fits well for incurred ages.

Figure 4.2

COMPARISON OF ACTUAL AND MODELED CLAIM COUNTS BY POLICY DURATION

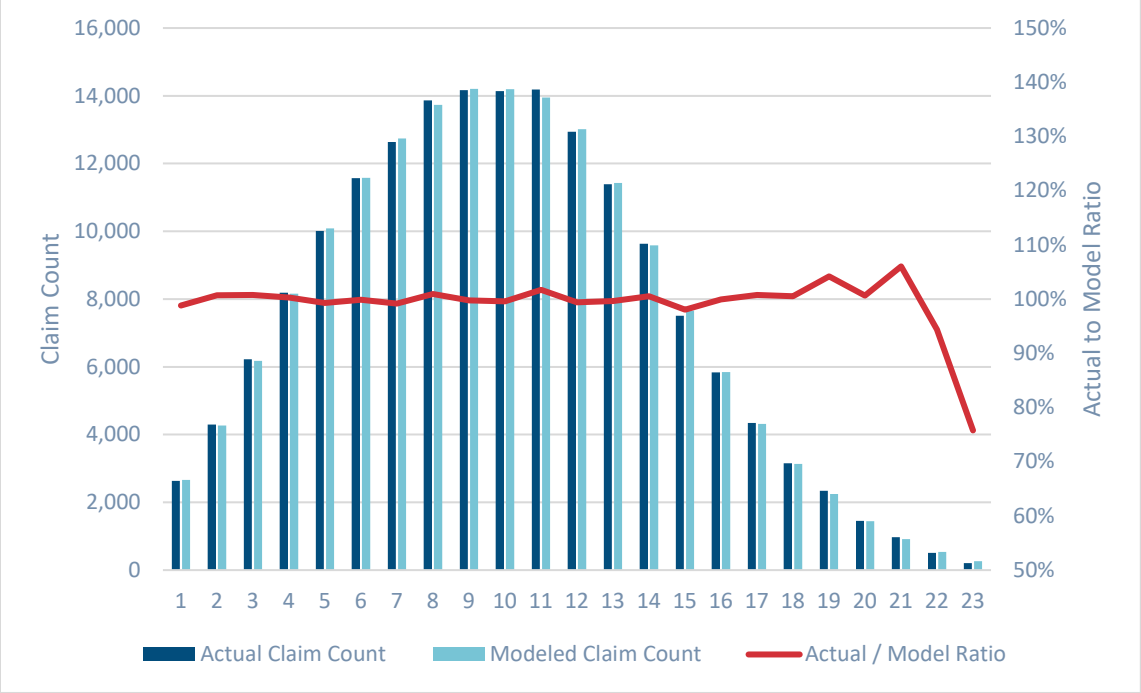


Figure 4.2 illustrates that, in general, the Model fits well for policy durations.

Figure 4.3A

COMPARISON OF ACTUAL AND MODELED CLAIM COUNTS BY CALENDAR YEAR

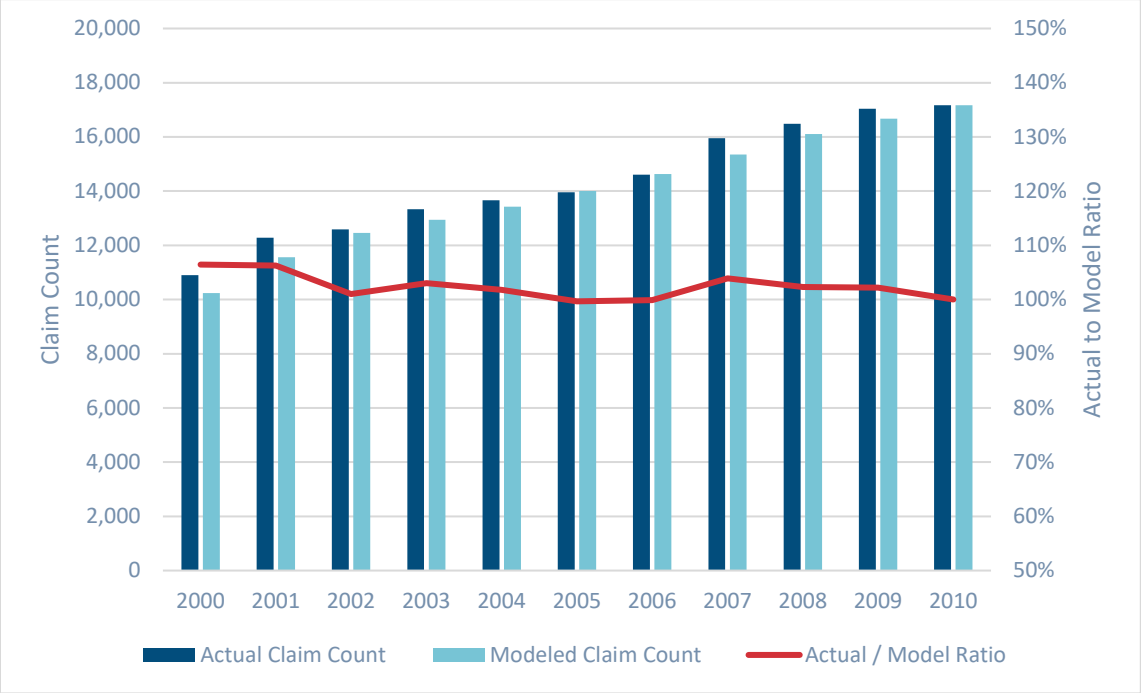


Figure 4.3B

COMPARISON OF ACTUAL AND MODELED CLAIM COUNTS BY ISSUE AGE

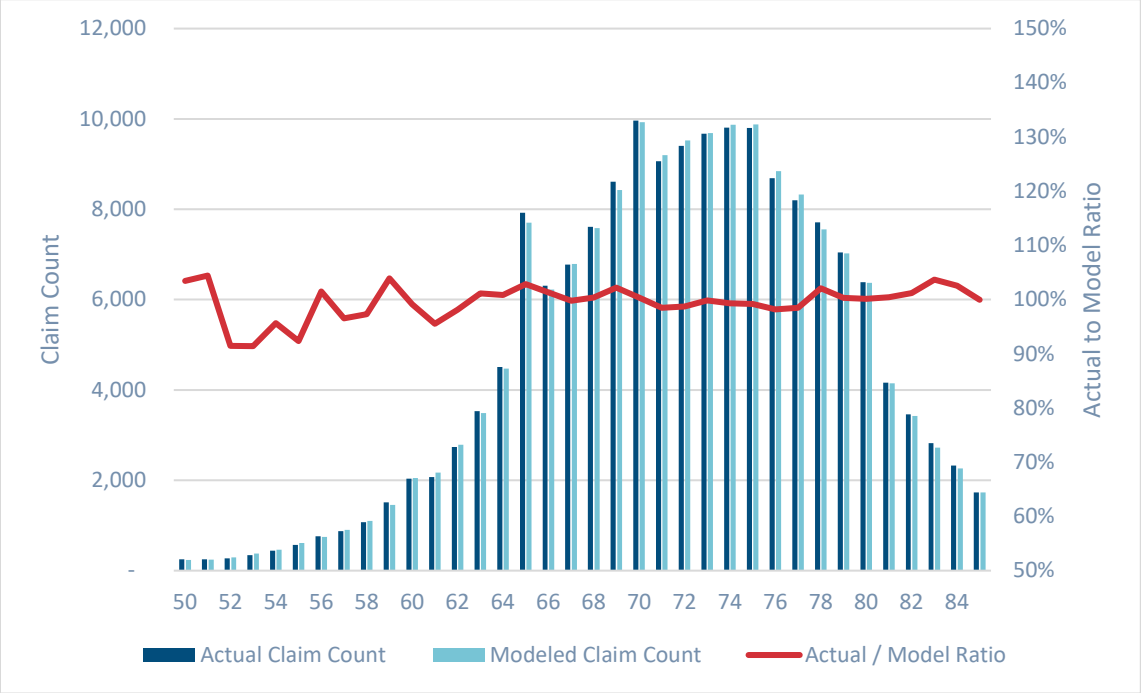


Figure 4.3A and Figure 4.3B represent fits of the analysis by characteristics not included in the model. Calendar year and issue age are not included in the model, but both fit generally well without inclusion in the model.

4.2 Considerations for Future Analyses

Throughout the engagement, several statistical methods were discussed that could be used to improve the analysis. These methods may be used in future studies and the reader is encouraged to review these methods.

Below are references to some additional methods that could be considered:

- Tests for Linear Trends in Proportions and Frequencies, P. Armitage 1955.
  - https://www.jstor.org/stable/3001775
- Methods for Strengthening the Common X^2 Tests, William Cochran 1954.
  - https://www.jstor.org/stable/3001616
- A Variance Components Approach to Categorical Data Models with Heterogenous Cell Populations: Analysis of Spatial Gradients in Lung Cancer Mortality Rates in North Carolina Counties, Kenneth Manton, Max Woodbury, Eric Stallard 1981.
  - https://www.jstor.org/stable/2530416
- Empirical Bayes Procedures for Stabilizing Maps of U.S. Cancer Mortality Rates, Kenneth Manton, Max Woodbury, Eric Stallard 1989.
  - https://www.jstor.org/stable/2289644

Additional statistical methods for increasing credibility, measure trends, and model fit may be used and should be considered when performing this type of analysis in the future.

4.3 Actual to Model Experience by 10-year Age Bands and Calendar Year

This section provides illustrations of the claim incidence rates by 10-year age bands. It presents actual incidence rates and modeled incidence rates. Each illustration also includes the claim counts incurred in each year to provide the reader a reference point to conduct credibility analysis.

In contrast to Method 1 described previously, each cohort described includes multiple characteristics as opposed to finding homogeneous cohorts. The Model should account for differences in various characteristics; however, the reader should carefully review the Model documentation prior to drawing conclusions from this analysis.

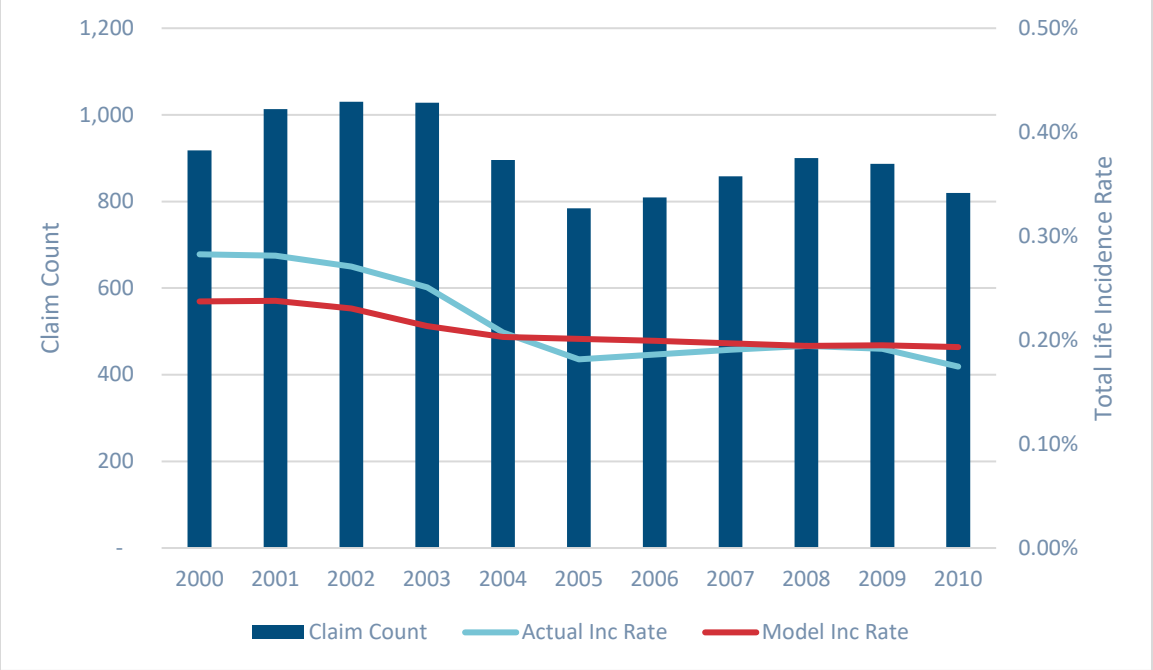
Because of the grouping of data, changes in the absolute incidence rate level alone by calendar year can be driven by changing demographics over time and should be examined further before drawing any conclusions. As an example, over a period of 11 years, the mixture of elimination periods, marital status, and gender could be very different. Each of those drive differences in expected incidence rates and can create uncertainty in the driver of the change in incidence rate changes.

Method 2 provides the opportunity to analyze trends over time on a more consolidated dataset. Factors not included in the Model may cause calendar-year trends. Method 2 does not provide an explanation of the cause of any calendar-year trends, but rather provides the ability to identify trends.

In Figure 4.4, experience for incurred ages from 60-69 across all characteristics is presented. It appears the actual incidence rate is higher than the model in the first four years, and generally lower than the model over the last six years. The actual rates declining faster than the Model may suggest improvement over time for this cohort.

Figure 4.4

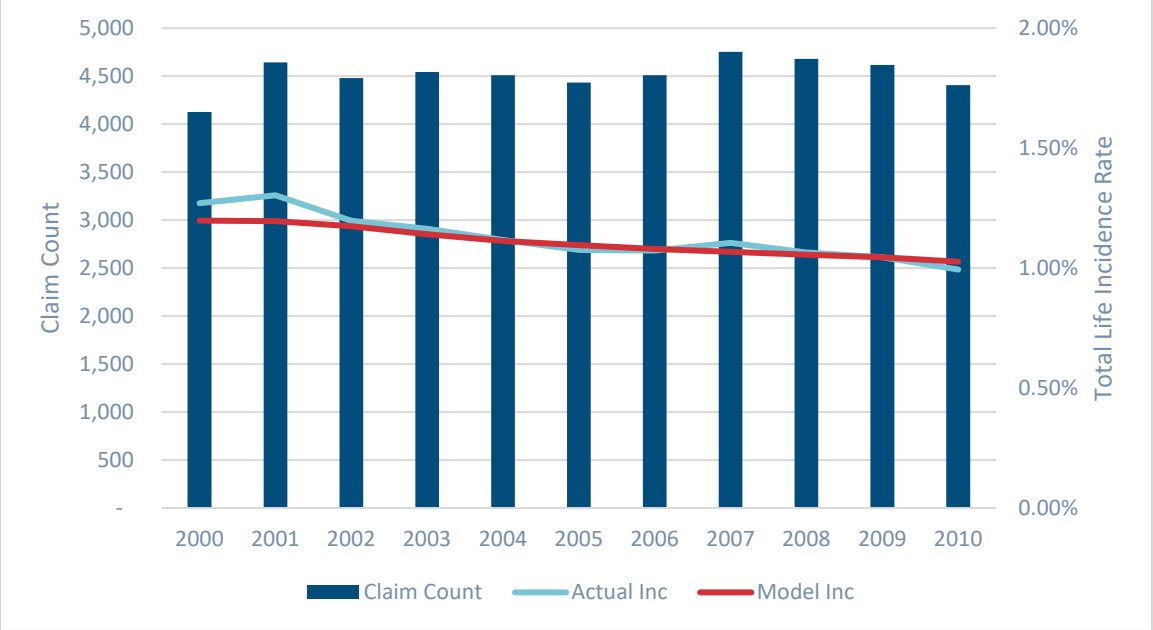
ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 60-69 BY CALENDAR YEAR



In Figure 4.5, experience for incurred ages 70-79 across all characteristics is presented. It appears the model fits well except for the first two years. The absolute actual and model incidence rates decline over time at generally the same rate. The overall change in incidence may be driven by characteristics other than the calendar year.

Figure 4.5

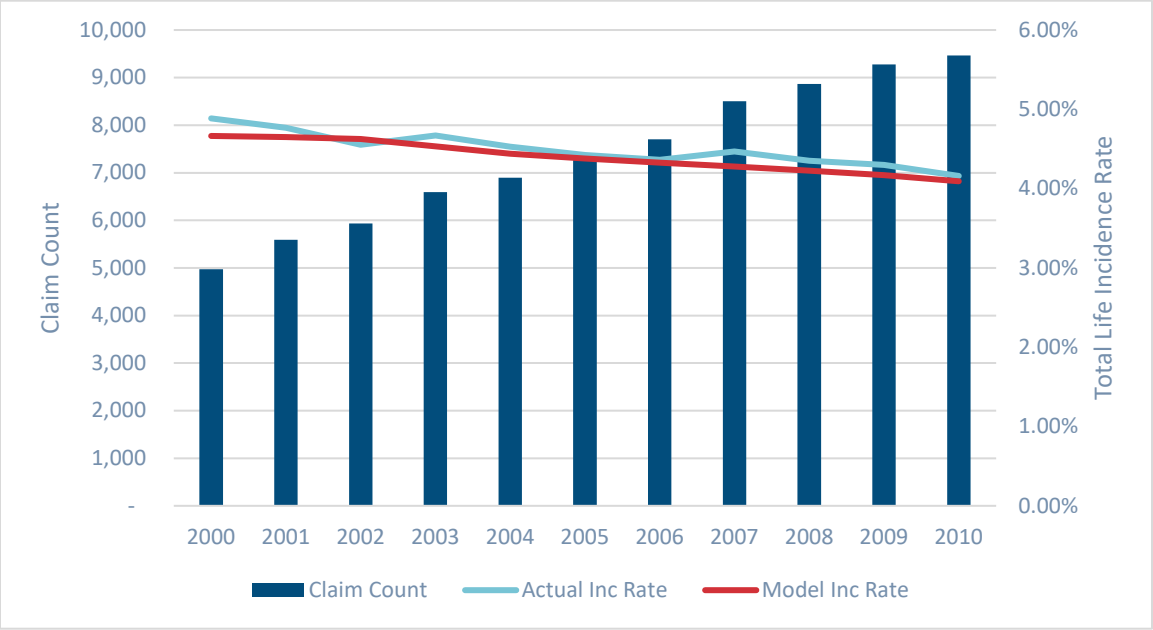
ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 70-79 BY CALENDAR YEAR



In Figure 4.6, experience for incurred ages 80-89 across all characteristics is presented. The model tracks the downward trend of the actual experience, which may be driven by the changing mix of business, but overall the model is slightly lower than the actual incidence rate for this dataset.

Figure 4.6

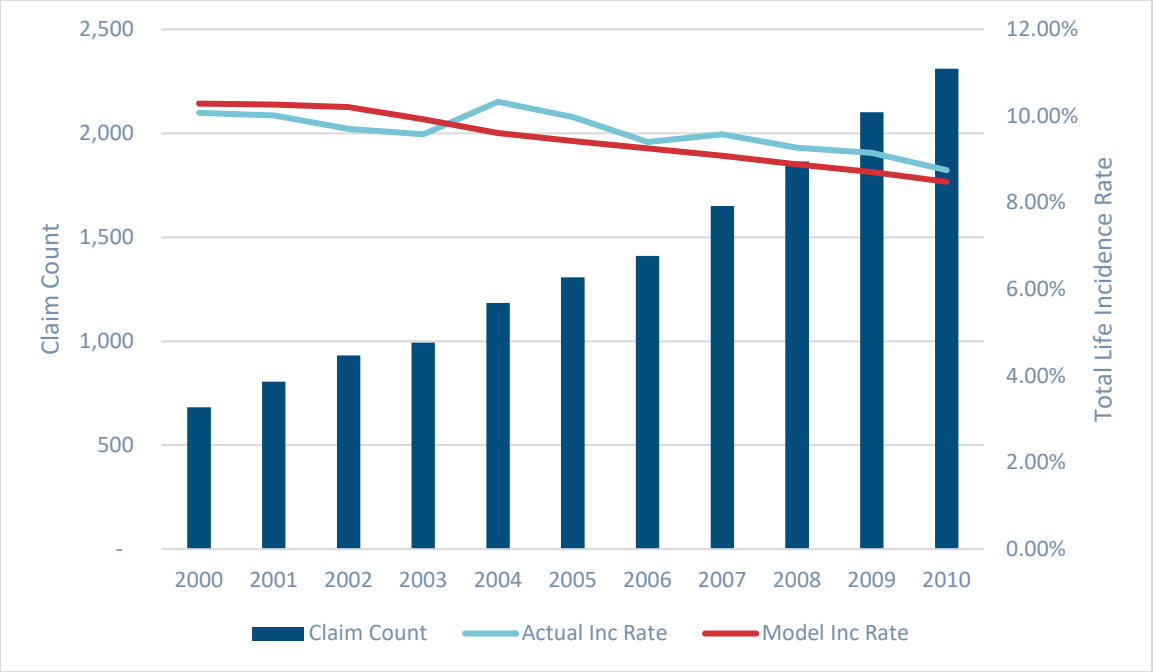
ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 80-89 BY CALENDAR YEAR



In Figure 4.7, experience for incurred ages 90-99 across all characteristics is presented. The actual incidence rate starts slightly lower than the model and increases over time to be slightly higher than the model. The actual rates appear to decline slower than the Model, which may suggest deterioration over time for the dataset relative to the Model.

Figure 4.7

ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 90-99 BY CALENDAR YEAR



4.4 Actual to Model Experience by Policy Duration Analysis

This section provides analysis of the claim incidence rates for two 10-year age bands and policy duration groupings. It presents actual incidence rates and modeled incidence rates. Each illustration also includes the claim counts incurred in each year.

The following graphs provide additional insight into the actual experience compared to the Model. To the extent the actual and modeled incidence rates follow a similar trajectory (increasing, flat, or decreasing), the changes over time are driven by the mix of business differences included in the model. If the trajectory of incidence rates over time is different, factors outside of the Model may be driving changes. Other factors, as described previously, influence incidence rates such as marital status, elimination period, etc. Calendar year, issue year, and issue age factors are not included in the Model.

Additional information can be found by 10-year age band in Appendix B.

Figure 4.8A

ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 70-79 BY CALENDAR YEAR, POLICY DURATIONS 1-9

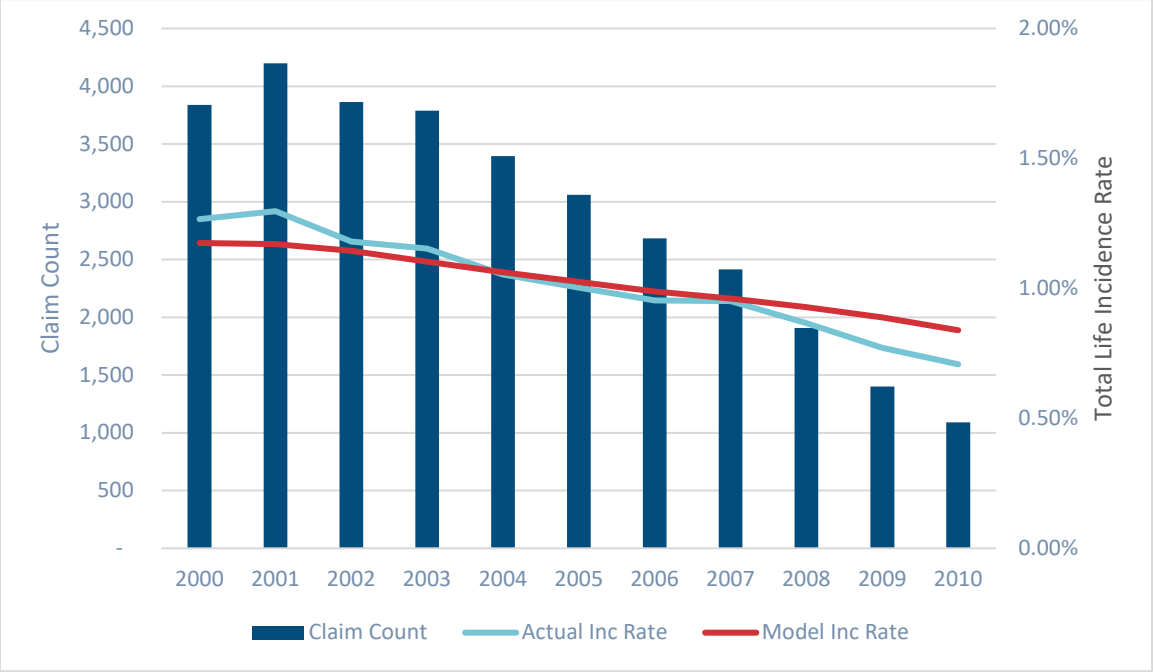
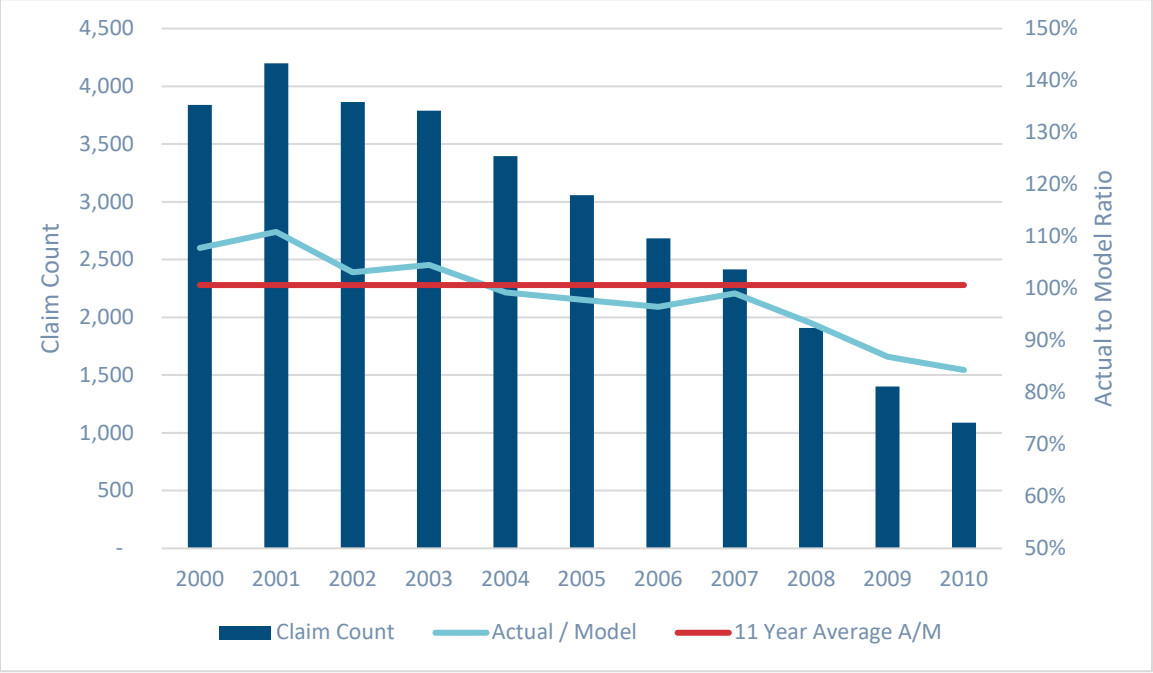


Figure 4.8B

ACTUAL AND MODEL RATIO, INCURRED AGES 70-79 BY CALENDAR YEAR, POLICY DURATIONS 1-9



Figures 4.8A and 4.8B indicate relative to the Model, actual incidence rates for 70-79-year olds in early durations (less than 10) are higher in the early years of this study and lower in the later years. The decreasing trend of actual rates relative to the model indicate improved experience over time. It's unclear as to the driver of this change, but may be attributed to underwriting changes, improved health status, product changes, or other factors not included in the model.

Figure 4.9A

ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 70-79 BY CALENDAR YEAR, POLICY DURATIONS 10+

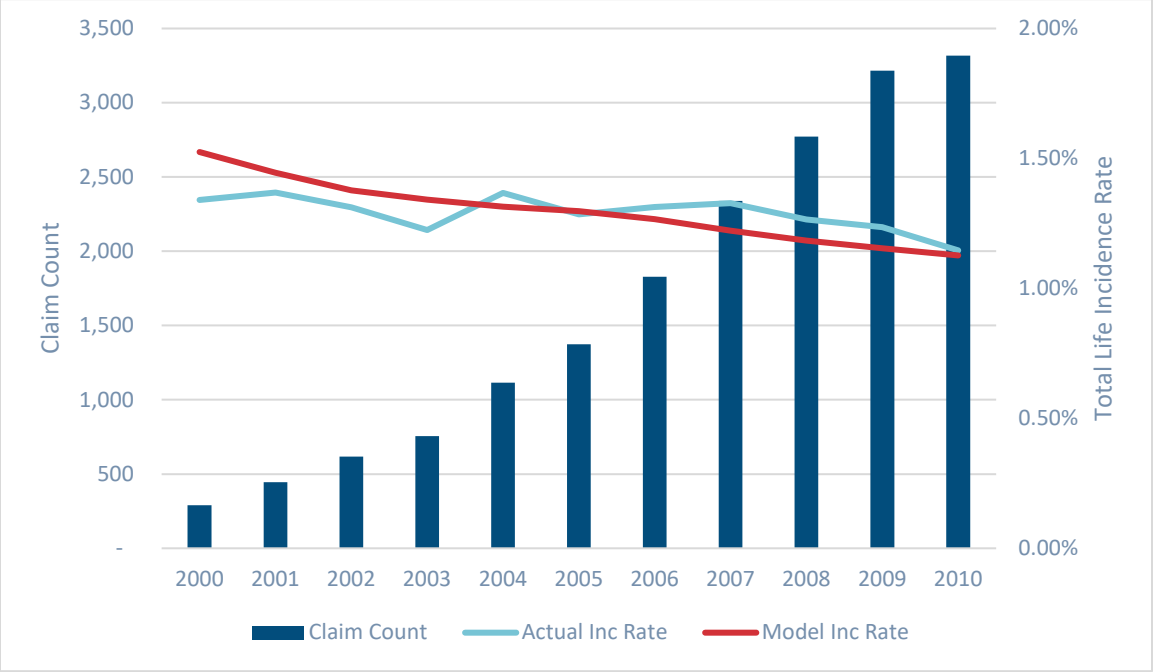
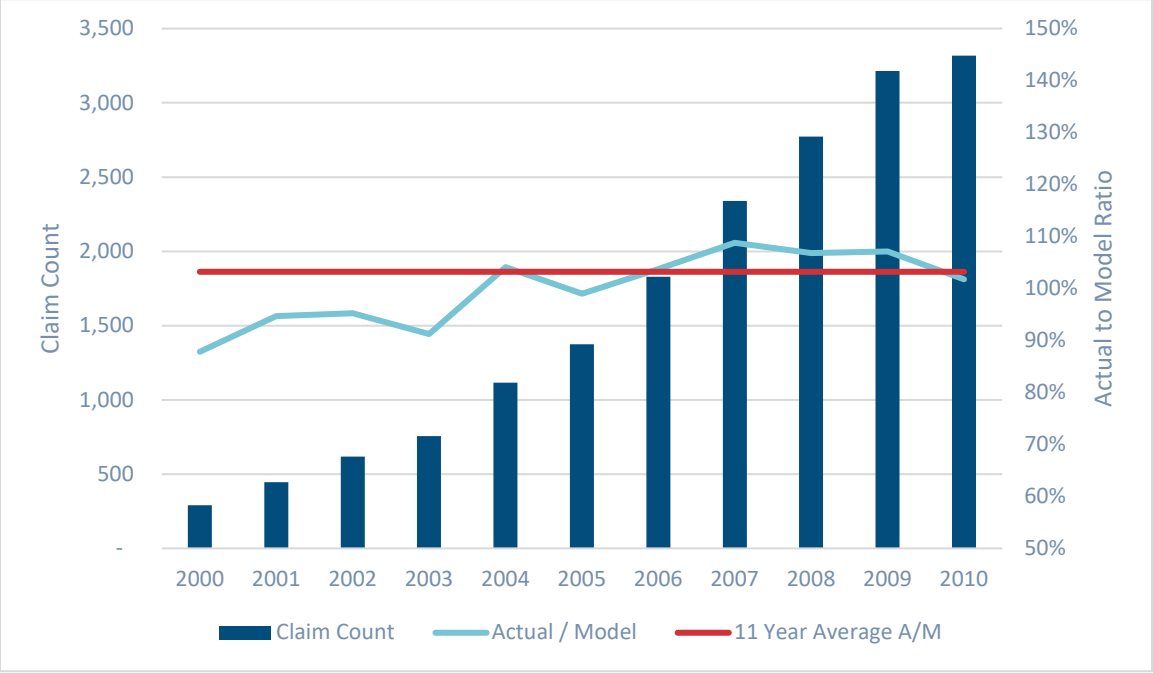


Figure 4.9B

ACTUAL AND MODEL RATIO, INCURRED AGES 70-79 BY CALENDAR YEAR, POLICY DURATIONS 10+



Figures 4.9A and 4.9B indicate relative to the Model, actual incidence rates for 70-79-year olds in later durations (greater than 10) are lower in the early years of this study and higher in the later years. The increasing trend of actual rates relative to the model indicate deteriorating experience over time. It's unclear as to the driver of this change, but may be attributed to underwriting changes, declining health status, product changes, or other factors not included in the model.

Figure 4.10A

ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 80-89 BY CALENDAR YEAR, POLICY DURATIONS 1-9

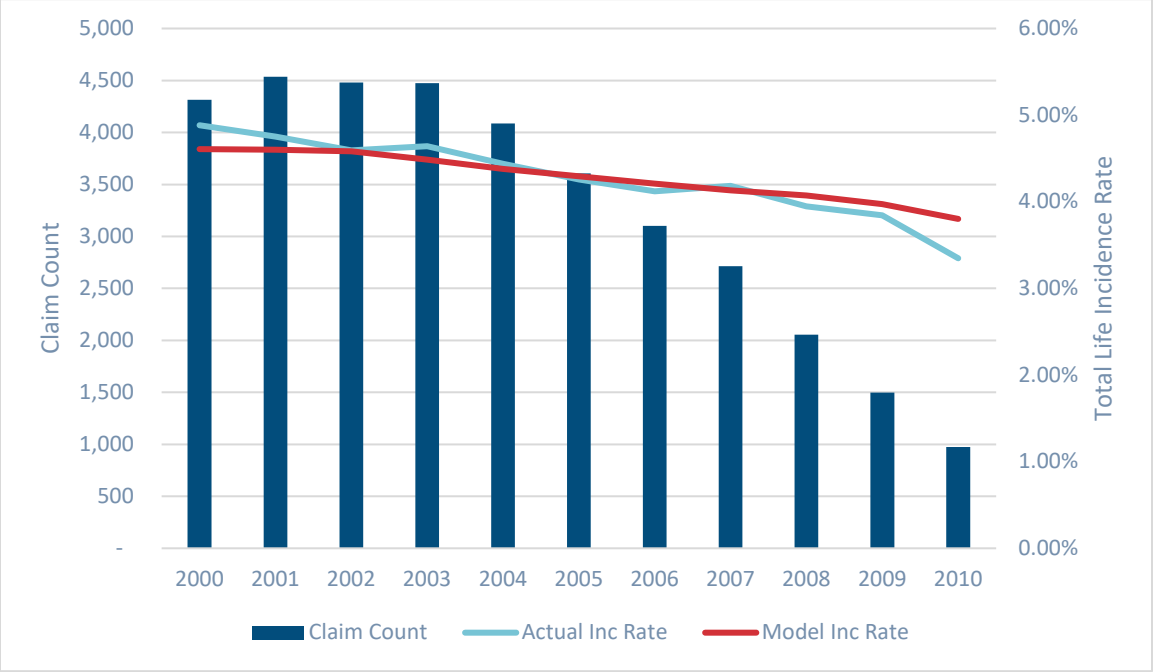
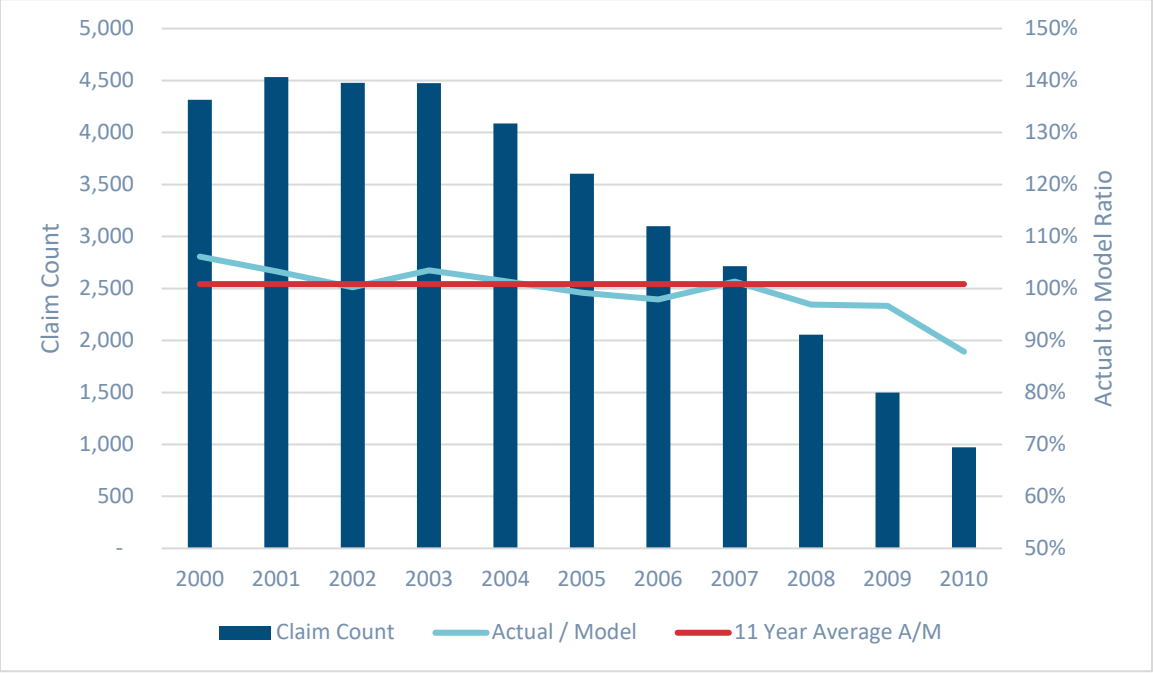


Figure 4.10B

ACTUAL AND MODEL RATIO, INCURRED AGES 80-89 BY CALENDAR YEAR, POLICY DURATIONS 1-9



Figures 4.10A and 4.10B indicate relative to the Model, actual incidence rates for 80-89-year olds in early durations (less than 10) are slightly higher in the early years of this study and slightly lower in the later years. The decreasing trend of actual rates relative to the model indicate improved experience over time. It's unclear as to the driver of this change, but may be attributed to underwriting changes, improved health status, product changes, or other factors not included in the model.

Figure 4.11A

ACTUAL AND MODEL INCIDENCE RATES, INCURRED AGES 80-89 BY CALENDAR YEAR, POLICY DURATIONS 10+

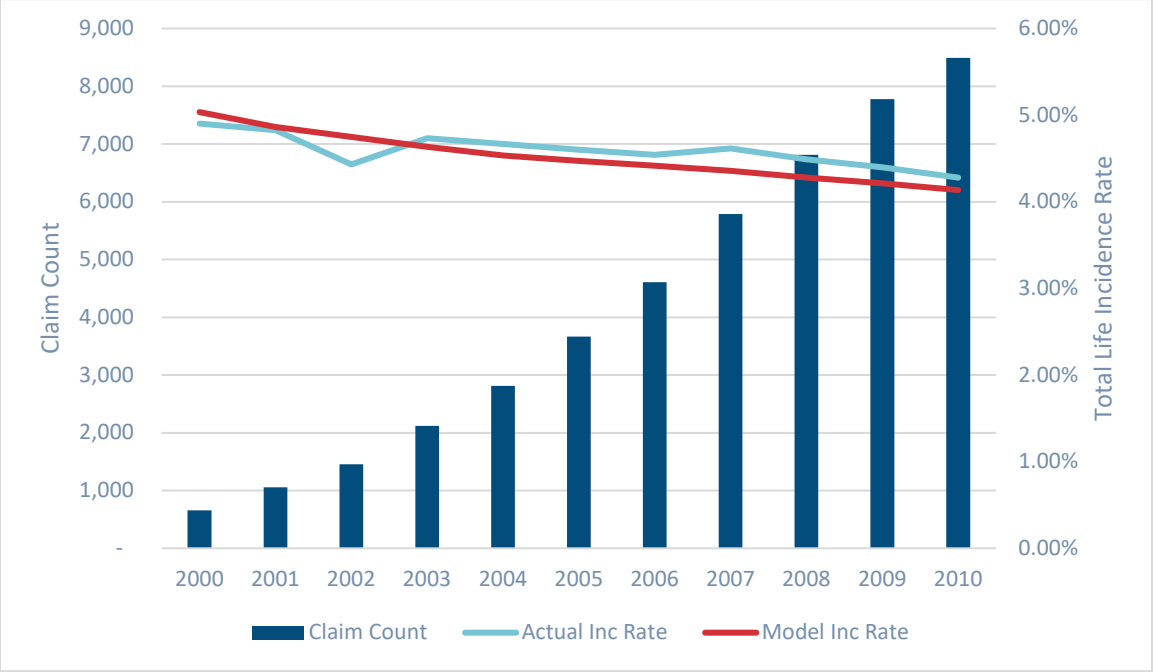
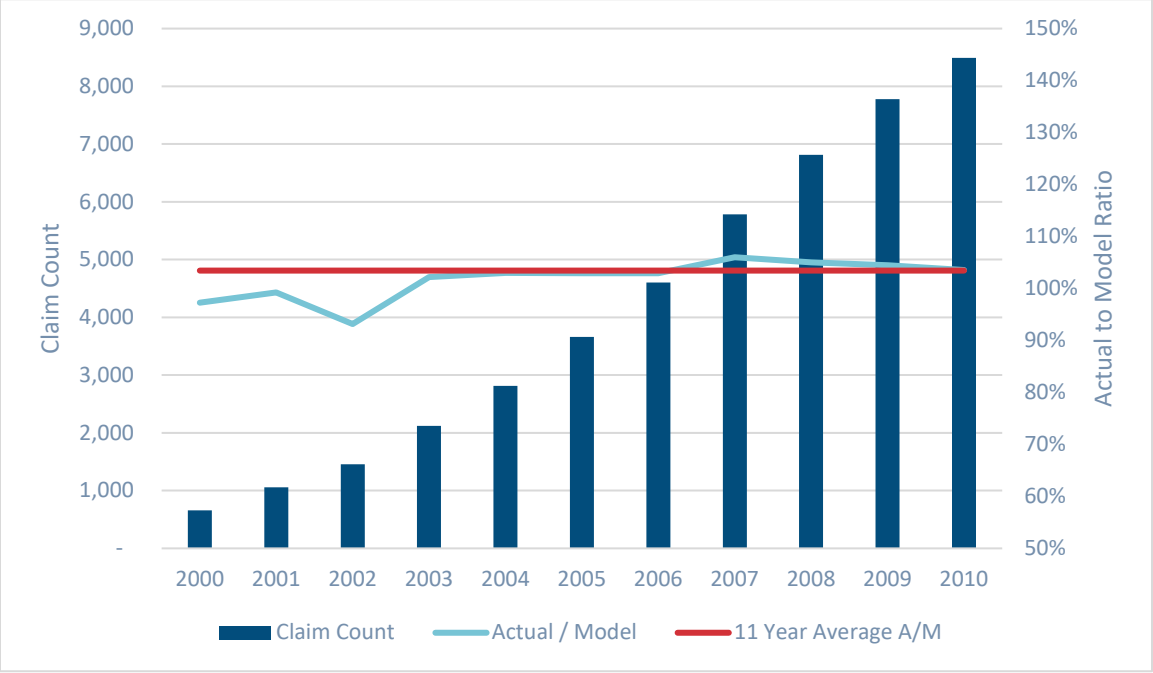


Figure 4.11B

ACTUAL AND MODEL RATIO, INCURRED AGES 80-89 BY CALENDAR YEAR, POLICY DURATIONS 10+



Figures 4.11A and 4.11B indicate relative to the Model, actual incidence rates for 80-89-year olds in later durations (greater than 10) are slightly lower in the early years of this study and slightly higher in the later years. It's unclear as to the driver of this change, but may be attributed to underwriting changes, declining health status, product changes, or other factors not included in the model.

4.5 Additional Actual to Model Illustration

In Appendix B, a series of actual to model illustrations are shown. The reader should consider each of these in isolation and in aggregate when reviewing the report.

4.6 Discussion of Issue Era

Long-term care insurance has evolved over time with changes including, but not limited to, benefit structure, underwriting techniques, target market, and risk selection. The experience included in this report covers experience from 2000 to 2010. Given the experience period, it is important to recognize that early policy duration and late policy duration experience may be generated from different issue eras.

The 2000-2011 LTC Experience Basic table was built based on the data provided and is limited to that experience. As a result, the Model implicitly connects issue eras together.

The experience data appears to have underlying trends by issue year and duration. These trends may suggest changes to underwriting techniques, risk selection, or product designs. The following graphs illustrate the issue-year trends.

The 4.12 Figures provide the actual to Model fit for several individual policy durations. Figures 4.12 A-D, issue year are displayed on the horizontal axis. These illustrations are intended to provide the reader with an understanding of the issue era differences that exist.

Figure 4.12A illustrates the model fit by issue year in policy duration 1. The graph indicates that actual incidence rates in policy duration 1 are lower than the Model predicts for more recent issue years. The light blue bars in the background indicate claim counts. Over 75% of the claims that occurred in policy duration 1 included in this data occurred on policies issued from 1999-2001.

Figure 4.12A

ACTUAL AND MODEL BY ISSUE YEAR, POLICY DURATION 1

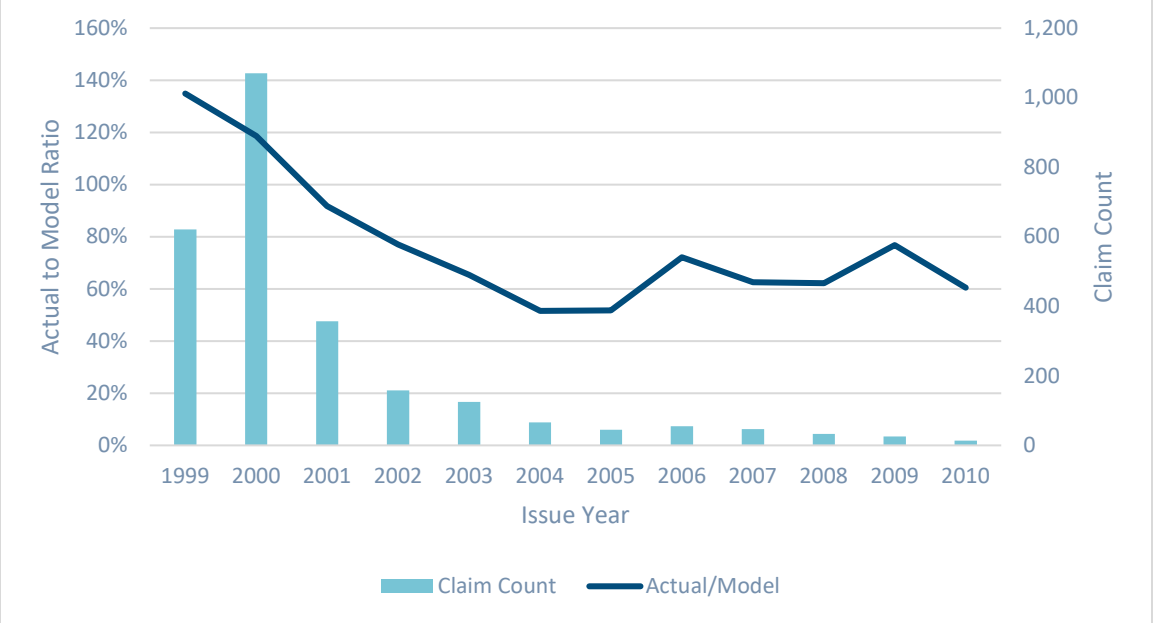


Figure 4.12B illustrates the model fit by issue year in policy duration 5. The graph indicates that actual incidence rates in policy duration 5 are lower than the Model predicts for more recent issue years.

Figure 4.12B

ACTUAL AND MODEL BY ISSUE YEAR, POLICY DURATION 5

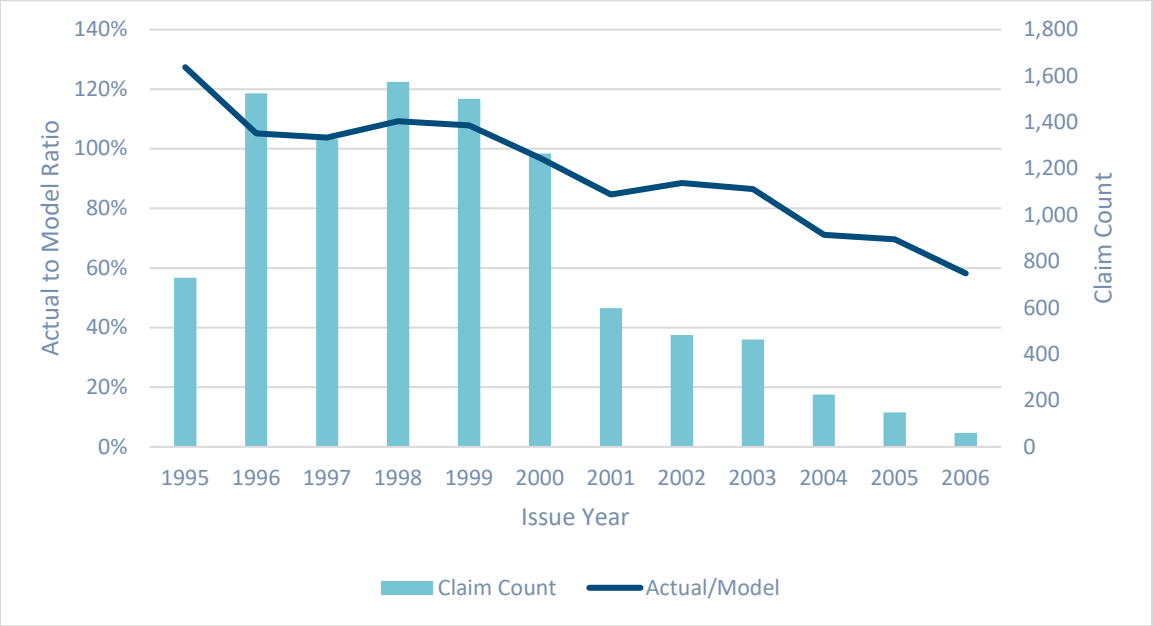


Figure 4.12C illustrates the model fit by issue year in policy duration 10. The graph indicates that actual incidence rates in policy duration 10 are generally in line with the model by issue year.

Figure 4.12C

ACTUAL AND MODEL BY ISSUE YEAR, POLICY DURATION 10

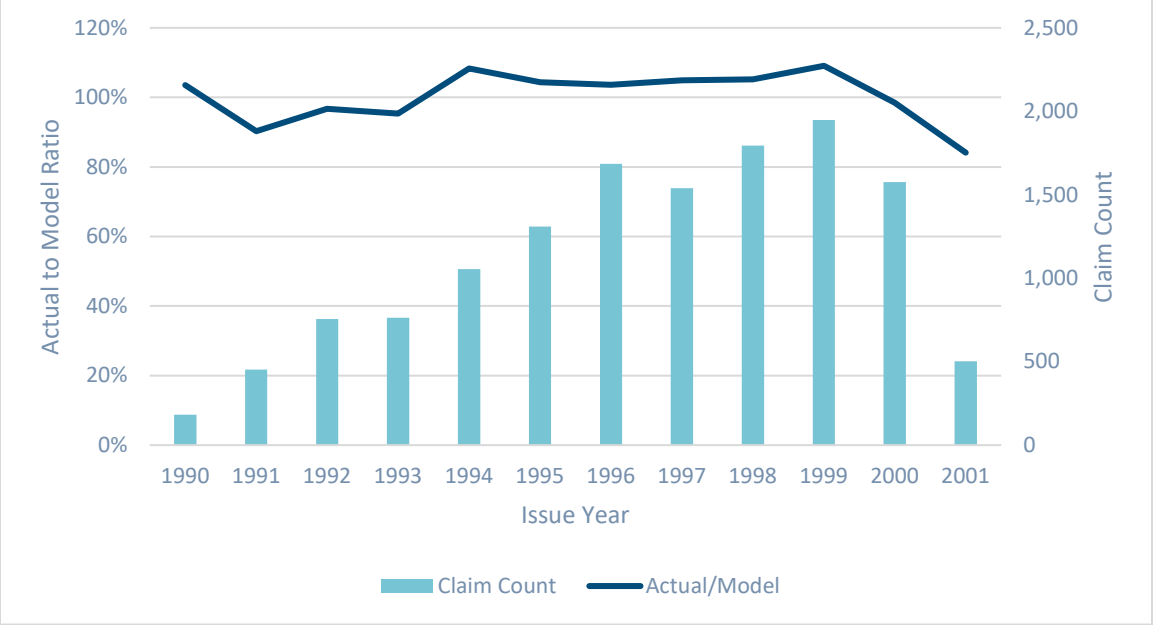
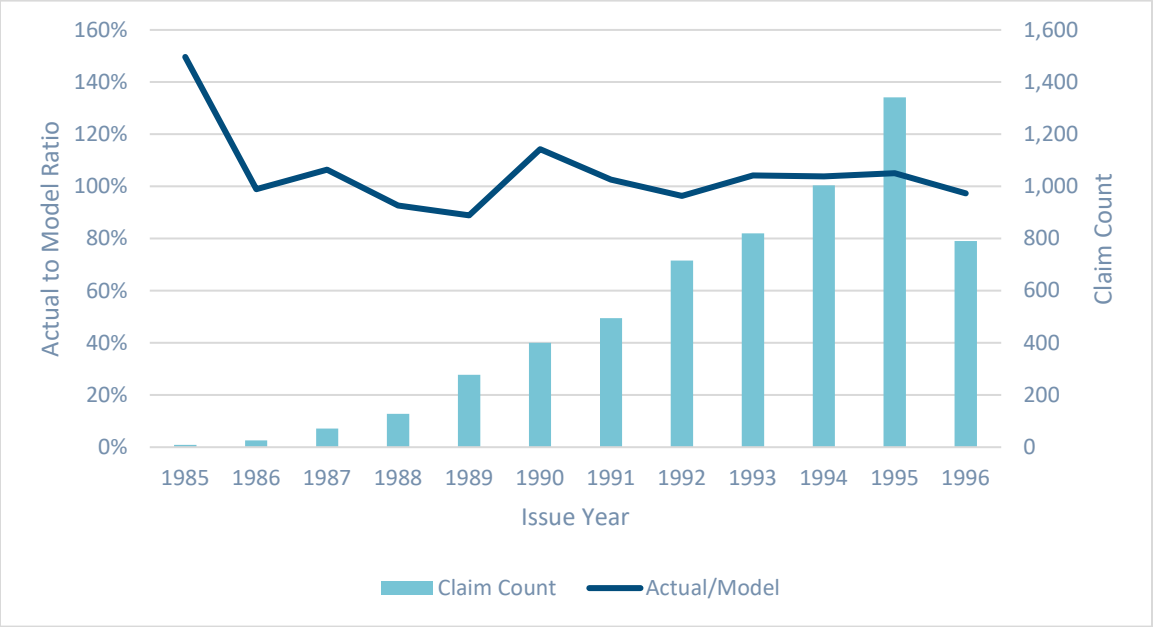


Figure 4.12D illustrates the model fit by issue year in policy duration 15. The graph indicates that actual incidence rates in policy duration 15 are generally in line with the model by issue year.

Figure 4.12D

ACTUAL AND MODEL BY ISSUE YEAR, POLICY DURATION 15



In summary, it appears from these illustrations that issue year has a significant impact on early duration experience relative to the model. Later durations do not appear to be impacted by issue year, but are limited to older issue eras. Late duration experience for more recent issue eras will be analyzed in future SOA Intercompany Experience Studies.

4.7 Discussion of Policy Duration

Appendix C provides an in-depth review of the policy duration factor contained in the model. Multiple interpretations may exist for this factor that have implications on the results of Method 2.

Section 5: Conclusions

There are multiple ways to analyze long-term care insurance experience to determine if calendar-year trends exist. Two methods have been described in this report, an observation-based analysis and an actual to model analysis. However, other types of analysis may be considered to determine if changes in historical experience exist.

For Method 1, the number of factors chosen to determine a homogeneous experience group is critical and will have a material impact on trends over time given the changing profile of the LTC industry. By selecting more variables, more certainty can be achieved that a homogeneous group is being observed. However, with each additional characteristic controlled for in the analysis, the dataset of claims to observe becomes smaller. Detailed analyses for many cohorts of experience can be found in Appendix A. The actual results can be shown to demonstrate declining, increasing, or flat incidence rates in certain cohorts by calendar year. It's unclear what is driving these changes, but it may be attributed to underwriting changes, health status changes, product changes, etc. Further, the trends over time become less discernable and potentially less reliable as cohort homogeneity is improved due to the smaller number of observations included in the cohort.

From Method 2, the patterns by policy duration and attained age suggest there have been changes in experience over time, most notably in early duration experience to date where the model and the actual results both show declining incidence rates by calendar year. It's unclear what is driving this change, but it may be the mix of business, underwriting changes, improving health status, product changes, etc. In later durations, there does not appear to be a discernable and consistent pattern between the actual and Model incidence rates.

Additional follow-up data needs to be collected to analyze if these changes are temporary or permanent. It is not completely understood why these differences exist as they may be driven by underwriting protocol changes, the mix of companies, policyholder purchase reasons, product differences, historical rate increases, or other reasons. Additional data collection around product and underwriting changes may be collected in the future and may be a consideration of future SOA Intercompany LTC Experience Studies.

It is important to note the presence of historical improvement or deterioration does not necessarily indicate that patterns will continue in the future. Assumptions about morbidity improvement in the future need to be considered like all other actuarial assumptions, with the use of many data sources. Additional data points that may need to be considered include, but are not limited to, company experience, population experience, and medical research.

The intent of this report is to provide methods of analysis, with actual data, to measure historical changes in experience. This report does not provide actuarial justification for any morbidity improvement assumptions, including positive, negative, or neutral future expectations.

Section 6: Caveats

This analysis is limited by the data used. The following are a list of considerations when reviewing this report:

- The data includes experience from many companies. As a result, the experience is an amalgamation of different risk cohorts.
- The long-term care industry's underwriting and risk selection have evolved over time.
- Claim administration protocols may vary by company.
- The mixture of experience weighted by company changes over time.
- These analyses considered 11 years of data. However, as seen in the report, there is an increasing number of claims each year. This provides more weight to recent experience.

The actual to model analysis should be considered with the following reliances:

- Calendar-year analysis for the actual to model approach is highly dependent on model choice. Other models may illustrate different trends.
- The use of a model built from a dataset to test for trends may have embedded inherent biases.
- Additional statistical methods may be applied

Considerations for assumption development:

- This report should not be considered an exhaustive study on morbidity trend analysis.
- Only incidence rates were considered over an 11-year period. No consideration for claim severity was included in this report.
- No consideration was made for changes in diagnosis in this analysis. Historical medical advances have not been considered and are outside the scope of this report.
- Future medical advancements are outside the scope of this report and are not considered.

Appendix A: Method 1 Analysis

Appendix A provides 236 unique combinations of data, which can be found in the SOA Method 1 Charts.xlsm file accompanying this report. Each tab in the Excel Appendix is a combination of:

- 5-year age band
- Gender
- Marital status
- Coverage type
- Minimum elimination period
- Policy duration grouping
- Underwriting type

For each cohort, a tab is presented. Cohorts with at least 100 claims over the entire period are displayed.

At the top of the tab, the risk stratification characteristics are displayed.

In the middle of the tab, a chart provides an illustration of the information for the cohort.

- The blue bar chart represents the incurred claim count in each year. These can be measured by the y-axis on the right side of the chart.
- The midpoint of the cross represents the incidence rate of the cohort in a given year. This can be measured against the y-axis on the left side of the chart.
- The top and bottom of the cross represent two standard errors for each point based on the exposure and claim counts associated with it.
- The red line represents the average incidence rate over the entire period.

At the bottom of each tab, a table of numbers is presented. These include the detail of the graph shown on the tab. In addition are metrics showing:

- The year over year change in incidence rate, including the average change and the weighted average change over the entire period.
- The ratio of actual incidence rate to the average incidence rate over the entire period, including the average ratio and the weighted average ratio over the entire period.
- The average attained age of the 5-year band in each year.

In addition, a statistical test was performed based on the test described in Section 4.2. In the Cochran-Armitage test, the null hypothesis states there is no linear trend in the data. The test's result produces a chi-square statistic. A high chi-square statistic produces a low p-score and indicates a rejection of the null hypothesis. For example, a p-score of less than 0.05 indicates a high probability of the existence of a linear trend. This test does not indicate the magnitude or direction of the slope, but rather that a trend exists. The slope of an unweighted linear regression line is provided to the reader in each table of Appendix A.

Appendix B: Method 2 Analysis

Appendix B provides 32 data groupings, which can be found in the SOA Method 2 Charts.xlsm file accompanying this report. Each tab in the Excel Appendix is a combination of:

- 10-year age band
- Gender
- Policy duration grouping

For each cohort, a tab is presented.

At the top of the tab, the risk stratification characteristics are displayed.

In the middle of the tab, there are two charts providing illustrations of the information for the dataset.

In the first graph:

- The blue bar chart represents the incurred claim count in each year. These can be measured by the y-axis on the right side of the chart.
- The red line represents the actual incidence rate for each year. This can be measured against the y-axis on the left side of the chart.
- The gray line represents the Model incidence rate for each year. This can be measured against the y-axis on the left side of the chart.

In the second graph:

- The blue bar chart represents the incurred claim count in each year. These can be measured by the y-axis on the right side of the chart.
- The midpoint of the cross represents the incidence rate of the cohort in a given year. This can be measured against the y-axis on the left side of the chart.
- The top and bottom of the cross represent two standard errors for each point based on the exposure and claim counts associated with it.
- The red line represents the overall average actual to model ratio for the cohort selected.

At the bottom of each tab, a table of numbers is presented. These include the detail of the graph shown on the tab. In addition are metrics showing:

- The ratio of actual incidence rate to the model incidence rate over the entire period, including the average ratio over the entire period.
- The year over year change in actual to model incidence rate.
- The actual to average ratio for each calendar year.

Appendix C: Analysis of Policy Duration Factor in Model

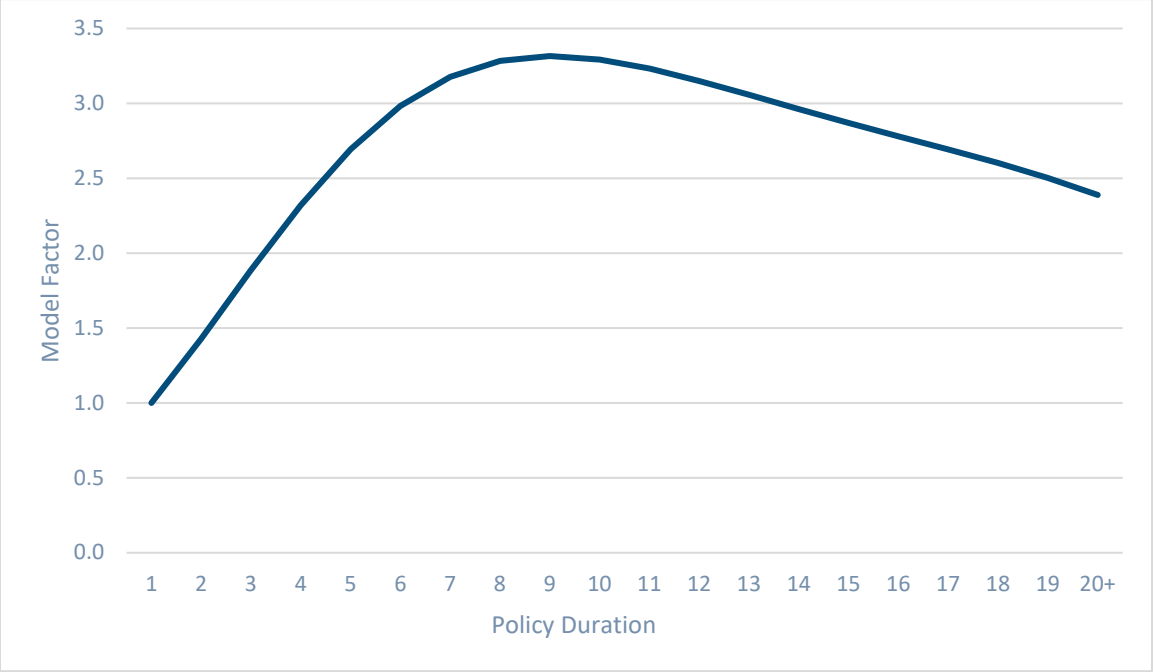
The Model contains a factor for policy duration. The factor was reviewed and discussed during this analysis as there may be an interpretation that the policy duration factor has historical trends built into the Model. If historical changes in incidence trends by calendar year exist and are embedded in the model, analysis of actual to model ratios may not provide insight into changes by calendar year.

It is important to note the generalized linear model used to create the basic table should be viewed in its entirety and no single factor should be viewed in isolation. As an example, moving from policy duration 1 to policy duration 2 is not the only characteristic that changes, as a policyholder will also increase attained age. The combination of all factors will provide a model that fits the dataset best. As a reminder, readers may review the model documentation available for a detailed explanation of the model build. The Model does not include calendar year, issue age, or issue year as a factor.

In Figure C.1, the policy duration factor included in the Model is shown. The shape of this factor created uncertainty in the applicability of the model to this analysis. Multiple interpretations of this factor are possible. The reader should carefully consider the shape of this factor, and all other factors in the incidence Model, prior to reaching conclusions from this analysis.

Figure C.1

POLICY DURATION FACTOR INCIDENCE MODEL – STANDARD UW CLASS



Specifically, within the experience model, by holding all other variables constant and decreasing issue age, the attained age incidence rate decreases because of the policy duration factor. As an example, an 80-year-old incidence rate issued to a 65-year-old is higher than the incidence rate for an 80-year-old with the same characteristics issued to a 64-year-old.

Using the Model to study attained age, an example can be created by selecting the following variables:

Figure C.2A

POLICY DURATION FACTOR INCIDENCE MODEL – STANDARD UW CLASS

Variable	Selection	Variable	Selection
Elim Period	100	Coverage	Comprehensive
Benefit Period	Limited	Region	Northeast
Tax Qual Status	TQ	Premium Class	Standard
Gender	Female	UW Type	Full
Max Daily Benefit	100	Marital Status	Married

Figure C.2B presents the resulting incidence rate per 1000 lives for each combination of issue age and duration at age 80. The shape of the incidence rates for attained age 80 by policy duration is similar to Figure C.1.

Figure C.2B

POLICY DURATION FACTOR INCIDENCE MODEL – STANDARD UW CLASS

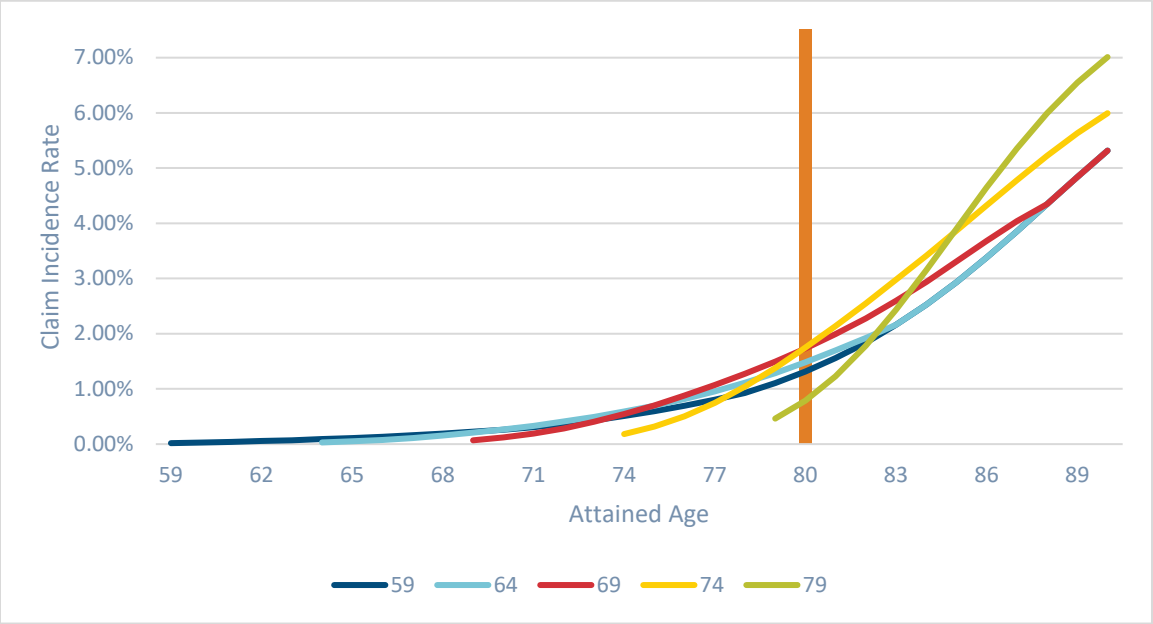
Attained Age	Policy Duration	Issue Age	Incidence Rate (Per 1000)
80	1	80	5.50
80	2	79	7.87
80	3	78	10.37
80	4	77	12.76
80	5	76	14.82
80	6	75	16.41
80	7	74	17.48
80	8	73	18.06
80	9	72	18.24
80	10	71	18.11
80	11	70	17.78
80	12	69	17.32
80	13	68	16.81
80	14	67	16.29
80	15	66	15.79
80	16	65	15.29
80	17	64	14.81
80	18	63	14.31
80	19	62	13.77
80	20	61	13.14

Figure C.2C presents the entire incidence rate curve for five issue ages. In Figure C.2B, only the attained age 80 rate is shown. In Figure C.2C, the attained age 80 incidence rate plots the modeled rate in the vertical selections, highlighted in orange or yellow in Figures C.2C, C.3D, and C.3E. Additional curves for each issue age were removed for illustration purposes only.

In Figure 4.3B earlier in the report, the illustration showed the model fit actual experience by issue age, even though the model does not include a factor for each issue age. The following illustrations provide additional analysis of the fit of the model.

Figure C.2C

COMPLETE INCIDENCE RATE CURVES FOR SELECT ISSUE AGES FROM FIGURE C.2B



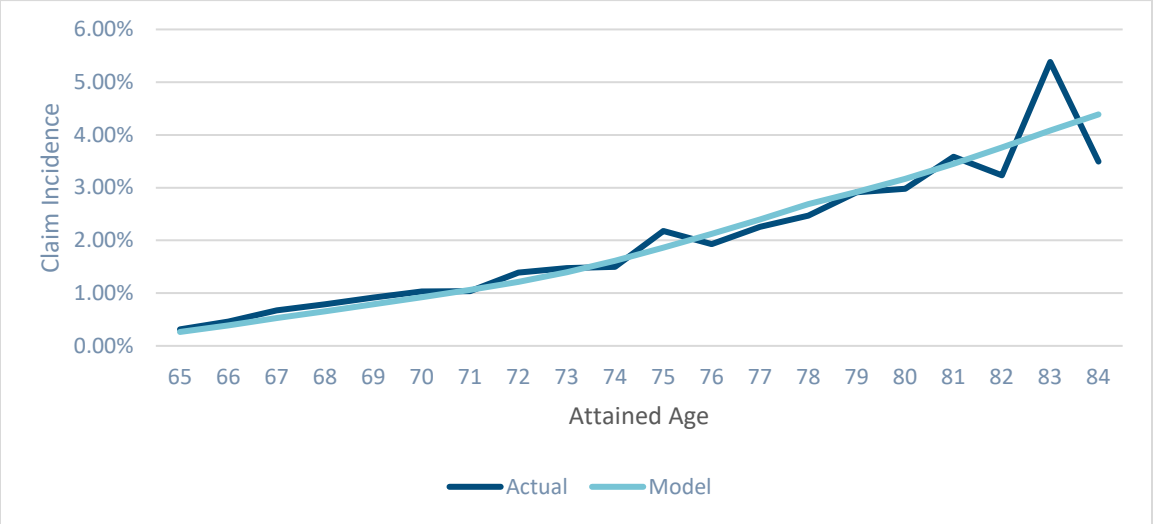
Upon further investigation, one interpretation of the data suggests the shape of the policy duration factor may be partially driven by the absence of issue-age adjustments. This possible interpretation is described below, but other interpretations, such as effects from calendar year or issue year of the policy may influence the shape of this factor.

In the graphs below, we show the actual to model fit of all female experience for various issue ages.

For issue age 65, the actual to model analysis indicates a good fit overall in Figure C.3A.

Figure C.3A

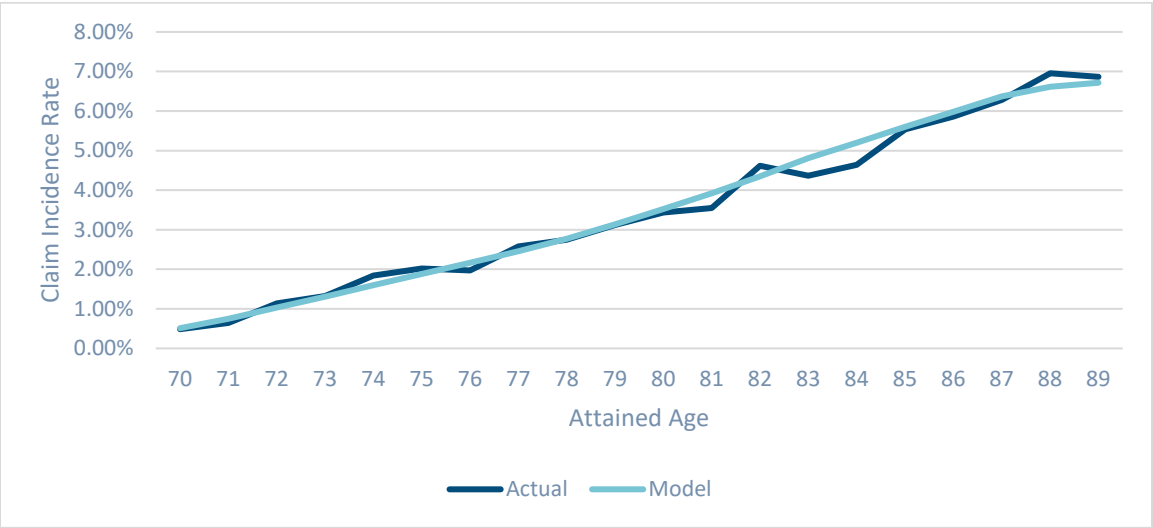
ACTUAL TO MODEL FIT: FEMALES ISSUE AGE 65



For issue age 70, the actual to model analysis indicates a good fit overall in Figure C.3B.

Figure C.3B

ACTUAL TO MODEL FIT: FEMALES ISSUE AGE 70



For issue age 75, the actual to model analysis indicates a good fit overall in Figure C.3C.

Figure C.3C

ACTUAL TO MODEL FIT: FEMALES ISSUE AGE 75

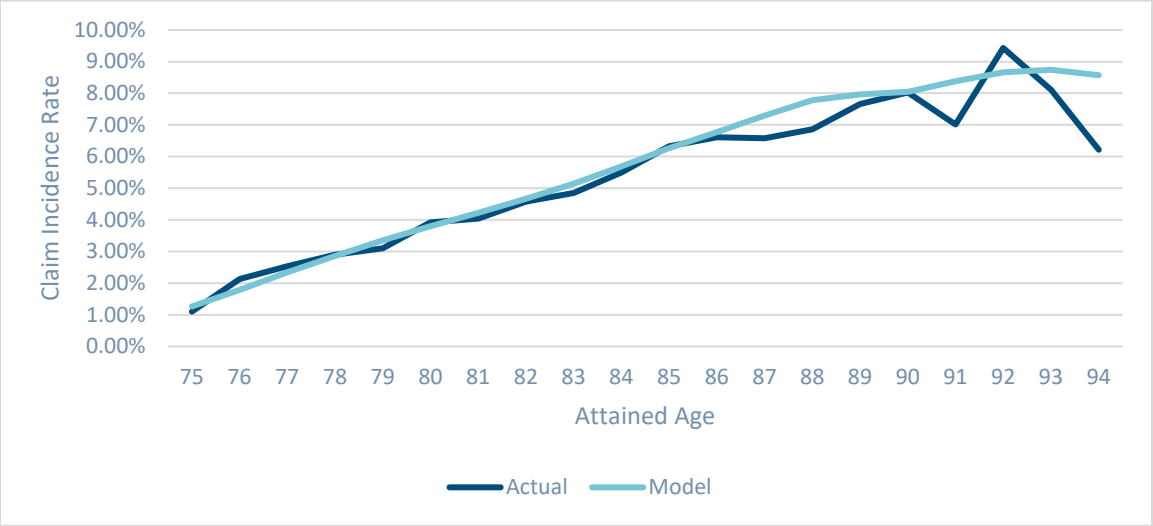


Figure C.3D

ACTUAL TO MODEL FIT: FEMALES ISSUE AGES 65, 70, 75

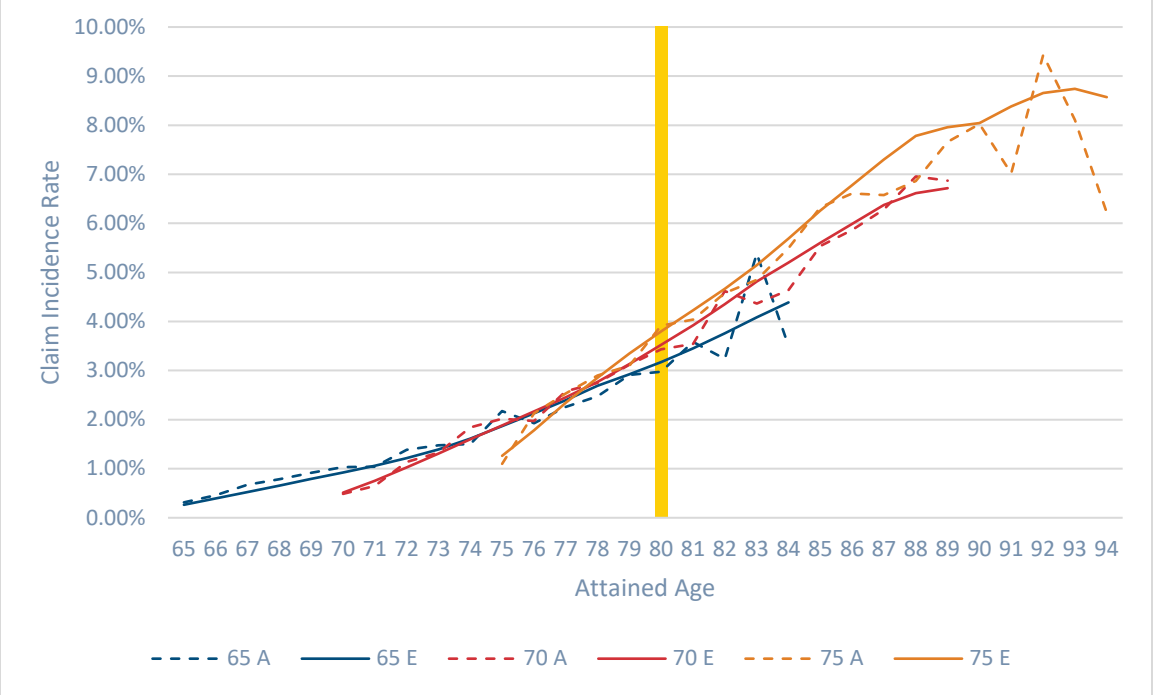
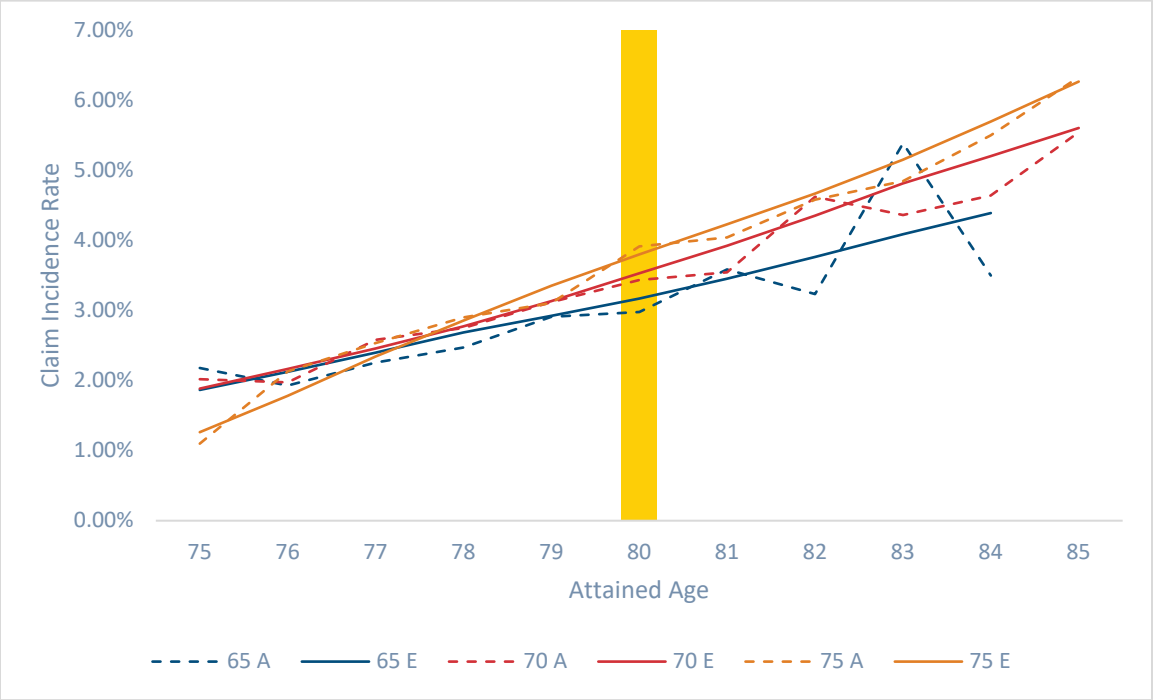


Figure C.3E provides a closer view of these incidence rates by limiting the horizontal axis to attained ages 70-80.

Figure C.3E

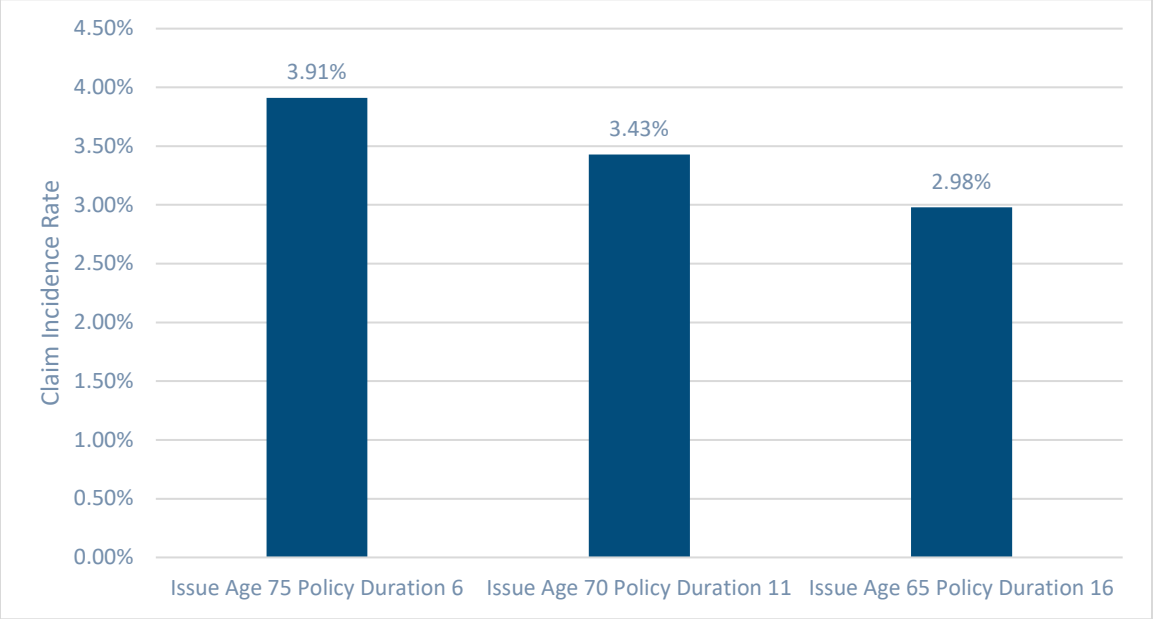
ACTUAL TO MODEL FIT: FEMALES ATTAINED AGES 65, 70, 75



A selection of an attained age, for example 80, from Figures C.3D-F, shows the incidence rate has a relationship between issue age, policy duration, and attained age.

Figure C.3F

ACTUAL INCIDENCE RATE, ATTAINED AGE 80; FEMALE SINGLE POPULATION



Although other interpretations of the Model may exist, it appears the shape of the policy duration factor may be connected to the absence of the issue age factor.

References

1) Aggregate database link:

   a. https://www.soa.org/experience-studies/2015/research-ltc-study-2000-11-aggregrated/

2) Experience Model report link:

   a. https://www.soa.org/experience-studies/2015/2000-2011-ltc-experience-basic-table-dev/

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