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Experience Studies—Understanding the past while planning for the future

by Matthew Dunscombe and Alex Zaidlin

Introduction

The experience study process serves as a primary foundation of actuarial work. Some of the first known actuarial work used experience study information to solve problems. The use of experience studies spans several centuries: from 17th century astronomer Edmund Halley using data on births and deaths for the town of Breslau for an analysis relating to annuities, all the way to 21st century actuaries who are now preparing to use assumptions derived from experience study output in principles-based reserve calculations.

Experience studies can help actuaries understand key drivers behind historical results. More importantly, conclusions drawn from experience analysis can play a starring role in the development of assumptions for pricing, valuation, and financial analyses. Some of the recent and expected changes in the capital requirements and financial reporting standards require companies to better understand their experience in order to value their business. Because of the need to derive company-specific assumptions, experience studies will continue to increase in importance to insurers in the United States and around the world.

By way of definition: an experience study is an exercise in analyzing certain events that occurred within a predetermined time period and that pertain to a given population. This population is often a block of insurance business. The study typically contrasts the occurred events (actual figures) with previously established expectations (the expected figures). The ratio of the actual figures to the expected figures yields a result popularly known as the actual-to-expected ratio (or A/E ratio). The aforementioned events, often referred to as trigger events, typically change the status of the insurance policy and often result in a financial loss or gain for

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the insurer. Examples include deaths, lapses, incidence of disability, termination of long-term care claims, and many others.

The experience study process

Virtually any event affecting an insurance policy can be the subject of an experience study. This paper focuses on describing mortality experience study methodology and related considerations. A traditional mortality experience study process can be broken down into seven key steps:

1. Gather and prepare source data
2. Perform exposure calculations
3. Calculate actual figures
4. Calculate expected figures
5. Aggregate study output
6. Analyze study output
7. Validate results and produce report

Gather and prepare source data

The first step in the process involves acquiring, understanding, and preparing the source data. This initial step can often be the most time-consuming and labor-intensive step. While scrubbing the data can be laborious, the investment is worth the time and effort and will ultimately result in more reliable study output. At this step, teaming up with the Administration, Claims, and IT departments can bring tremendous benefit to the actuaries conducting the study. Individuals from these areas could identify sources of relevant information, shed light on irregular patterns, and help backfill missing values in the data.

There are two common data structures that can be used to complete an experience study: a policy snapshot dataset and a transactional records dataset. A policy snapshot dataset contains one record for each policy, whether terminated or active, and includes policy specifics and policyholder characteristics. A transactional records dataset contains one record for each of the transactions administered for the studied policies. Example of transactions include: deaths, renewals, issues, lapses, face amount changes, reinstatements, and conversions.

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To incorporate claims data into the study when using the policy snapshot dataset, it is necessary to link claim records (obtained from a separate extract dataset) to the policy records. A unique common field in the policy records and claim records, such as policy ID number, can be used as a key field to link the two files.

Typically, the actuary makes a decision on which data structure(s) to use for the study. Some considerations for deciding on the data structure(s) for a particular study may include: the ease of acquiring each dataset, the size of the source dataset, the level of flexibility needed with regards to changing the study period, the ease in linking policy and claim records, and the degree of precision required for critical study fields. Obtaining both datasets can be beneficial for the purposes of data reconciliation and backfilling missing values.

Once the data structure is selected, the actuary decides which data fields to include in the study. In selecting the desired data fields to be used, the actuary will strive for a delicate balance between granularity and efficiency of the study. Additional data fields allow for more granular analysis of the data, but may create data clutter and slow down the study process. Product and policyholder specifics are crucial to incorporate into the study in order to facilitate robust assumption development. Including these items will allow the actuary to drill into the various potential drivers of experience differences. For instance, the lapse rate structure for level term life policies likely differs from that for universal life policies; separating these products would add value to the experience study. An industry table used by the company can serve as a good starting point for the study data field inventory; however, the final set of data fields in the study should vary with company-specific modeling considerations and particular features of the business.

Perform exposure calculations

After selecting the data structure and data fields, acquiring and preparing the data for the use in the experience study, exposure figures (commonly referred to as "exposures") can be calculated for the studied policies. While a detailed explanation of the nuances involved in the exposure calculations is beyond the scope of this article, a few points will be made.

Exposure figures provide a measure of susceptibility of the studied policies to the trigger event, in our case, mortality. Dividing claims by exposure figures yields a rate of claims. This measure can be presented using count of claims divided by exposure years and summed face amount of claims divided by summed exposure amount – referred to as "by count" and "by amount" rates of claims. Measures by amount are used chiefly by many actuaries, since they quantify the financial impact of the trigger event on the company. Measures by count provide an additional perspective, since claim size is omitted and possible distortions from large claims are removed.

The mortality experience study can be conducted either by policy year or calendar year. Policy year studies allow for simpler policy duration calculations, since each study year would correspond to a specific policy duration. On the other hand, calendar year studies require some manipulation to align policy durations with calendar years. A common practice for a calendar year study is to include two exposure segments for each policy, within each calendar year in the study horizon. The first exposure segment would be for the time interval prior to the policy anniversary, while the second exposure segment would be for the time interval after the policy anniversary. Relevant dates for each policy are central to the exposure calculations. Depending on the available source data, the policy duration may need to be calculated by the actuary or may be available directly as a field in the source data.

Here is an example of applying exposure calculations to a policy record. Table 1 shows the policy record.

Table 1: Policy Data

Policy Number	Issue Date	Face Amount
11111	04/01/06	200,000

For a calendar year study covering a study period from 2010-2012, the policy record generates six exposure segments, as illustrated in Table 2 (on page 6).

Calculate actual figures

Claims data is used to calculate actual claim figures (commonly referred to as "actuals") for the mortality experience study. Actuaries often struggle with understanding and verifying data elements in the claim files, as these data elements are frequently less systematic and consistent than data in the policy administration system. Maintaining open dialogue between actuaries conducting the study and the claims staff is critical, in order to ensure proper interpretation and use of the claims data.

Claim records will need to be joined to the corresponding policy records when using the policy snapshot dataset. Each claim record should have a corresponding policy record in the policy snapshot—this ensures that only claims relevant to the studied block are selected. Depending on the data structure within the company, claims data may contain additional information that could be of interest to the actuary conducting the study. For instance, cause or location of death could be used when grouping the study results and may provide a different perspective on the experience.

Calculate expected figures

The next major step involves importing mortality rates and other assumptions from external sources to the experience study engine. These rates and assumptions are applied to the exposure figures calculated earlier in the process. Expected figures are then calculated using various expected bases. Expected bases may include industry tables, pricing assumptions, modeling or valuation assumptions, and/or other bases relevant to the specific study. The expected claims under the various bases can be compared to the actual claims observed over the study period.

Table 3 (on page 6) displays a sample experience study record, with calculated exposure of 0.50 years.

For this example, we will use an industry table, the SOA 1975-80 Table, as the basis for expected claims. This

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Table 2: Study Records after Applying Exposure Calculations

Policy Number	Study Year	Face Amount	Next Anniversary	Exposure Start Date	Exposure End Date	Policy Year	Exposure Count	Exposure Amount
11111	2010	200,000	04/01/10	01/01/10	03/31/10	4	0.25	50,000
11111	2010	200,000	04/01/11	04/01/10	12/31/10	5	0.75	150,000
11111	2011	200,000	04/01/11	01/01/11	03/31/11	5	0.25	50,000
11111	2011	200,000	04/01/12	04/01/11	12/31/11	6	0.75	150,000
11111	2012	200,000	04/01/12	01/01/12	03/31/12	6	0.25	50,000
11111	2012	200,000	04/01/13	04/01/12	12/31/12	7	0.75	150,000

Table 3: Sample Policy Record after Exposure Calculation

Policy Number	Gender	Issue Age	Age Basis	Policy Year	Exposure Count	Exposure Amount
12345	M	40	ANB	8	0.50	100,000

example policy was issued to a 40-year-old male on the age nearest birthday basis and is currently in policy duration 8. For this record, the tabular mortality rate from the above industry table is 0.00279.

The tabular mortality rate can be applied to the exposure count and exposure amount to derive the tabular count and tabular amount. For the policy in the example, this is as follows.

$$\text{Tabular count} = \text{exposure count} \times \text{tabular rate} = 0.50 \times 0.00279 = 0.001395.$$

$$\text{Tabular amount} = \text{exposure amount} \times \text{tabular rate} = 100{,}000 \times 0.00279 = 279.$$

Aggregate study output

At this step, the actual and expected figures are aggregated in accordance with the study requirements. The level of aggregation will vary based on the goal of the study. In setting or assessing pricing assumptions, for instance, the groupings may be more refined than when setting or assessing valuation assumptions.

To clearly illustrate the aggregation process, the only grouping criterion used in the example below is gender. There are six records in Table 4. Each record belongs to a unique policy. In this example, the tabular amount column contains the expected figures.

After grouping by gender, the table is condensed from six records to two records, as shown in Table 5.

The compressed table is smaller and retains only the fields defined in the grouping criteria. The amount fields (actual amount, exposure amount, and tabular amount) in the grouped table are summed within each grouped record. Note that the total of the amount fields should be the same for the seriatim record set as it is for the grouped record set.

Considerations central in setting the aggregation criteria relate to the credibility of the output groupings (also referred to as cells.) These considerations can play a major role in determining the reliability and utility of experience study output. There are several methods in current practice that can be used to calculate credibility of study output. It is up to the actuary conducting the study to decide on a preferred method. One popular approach blends partially credible results with a chosen benchmark table (e.g., adjusted industry tables or currently used assumption tables). For some companies or blocks of business, it may be reasonable to forgo a detailed breakdown by risk factors in favor of obtaining credible business segment cells. It is common practice to group pseudo-continuous variables, such as age or policy duration, to generate more credible results for low-credibility business segments. A relatively new methodology to improve the credibility of study output involves the use of generalized linear models. By relying on Bayesian credibility theory, these models arrive at a posterior distribution of study output using some prior function and partially credible information derived from the study.

Table 4: Seriatim Records

Policy Number	Issue Date	Gender	Issue Age	Actual Amount	Exposure Amount	Tabular Amount
11112	04/01/06	F	48	0	200,000	564
22222	07/01/04	M	34	0	50,000	79
33333	03/01/08	M	42	100,000	100,000	180
44444	08/01/97	M	41	0	75,000	534
55555	12/31/99	M	45	0	250,000	1,268
66666	06/01/10	F	37	0	125,000	73
Total				100,000	800,000	2,698

Table 5: Grouped Records

Gender	Actual Amount	Exposure Amount	Tabular Amount
F	0	325,000	637
M	100,000	475,000	2,061
Total	100,000	800,000	2,698

Analyze study output

The experience study output, often containing unexpected or even surprising patterns, represents the recent history of the block of business. There are many considerations that arise when it is time to review the resulting actual-to-expected experience ratios. While not exhaustive, the list below includes some key issues to consider.

1. Trends

a. Did the experience improve or worsen over time?
b. Were the changes in experience over time aligned with changes in underwriting or other risk management practices?
c. Were the changes in experience over time aligned with any economic or regulatory changes?
d. Were there any sharp spikes or troughs in certain years? If so, why did they occur?
e. Were there certain blocks of business that exhibited different than expected trends? Why?
f. Were experience changes driven by a shift in the mix of covered products? Did changes in the demographic mix have any impact on the experience?
g. Did the experience generally move in one direction over the years, or did it fluctuate in a seemingly random manner?

2. Outliers

a. Were there any business cells that showed significantly different results from the rest of the business? Were extreme values caused by large claims or data issues?
b. Did external factors come into play in the experience of a block of business? Could these factors affect the business in the future?
c. What can be done in the future to mitigate the impact of outliers on experience?

3. Relationships

a. What were the key risk factors driving the experience?
b. How did various risk factors interact with each other? Did result analysis show any correlation between factors?
c. How did mortality experience by underwriting class fare? Was mortality for preferred risk classes lower than mortality for residual risk classes? If so, by how much?

Since analyzing study output is a key step in the experience study process, it is good practice to have an independent peer review process in place. The peer reviewer would provide an additional level of assurance that the study output is interpreted appropriately and could offer additional insight from the reviewer's personal experience.

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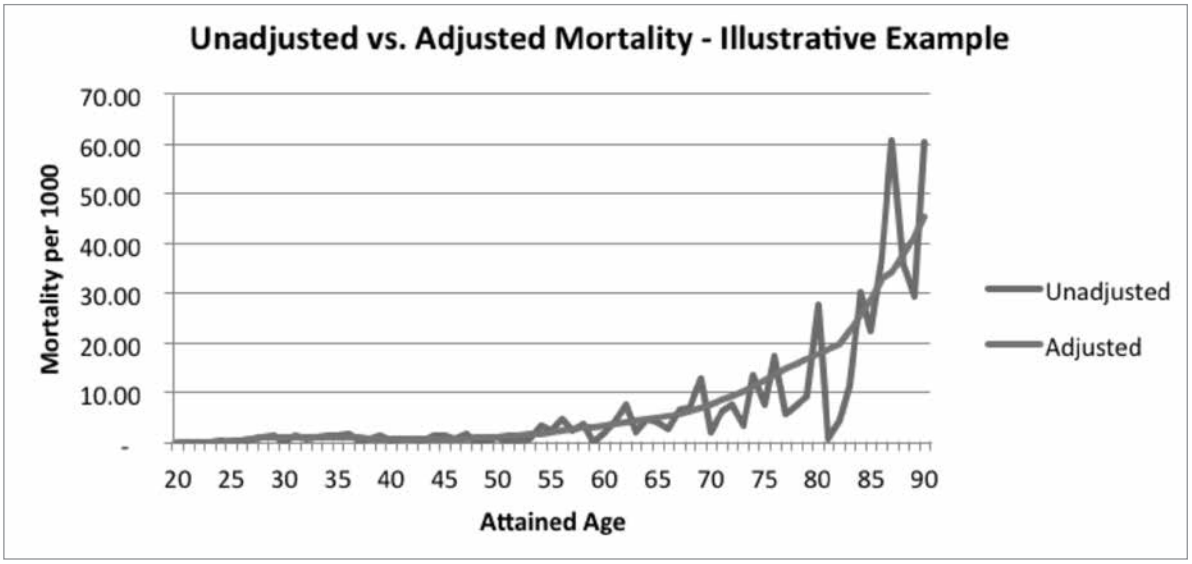
Once the output is reviewed and the actuary is comfortable with the trends, outliers, and relationships observed in the study, the actuary may consider making manual adjustments to the study output. Manual adjustments are often critical to make study results useable. Result volatility is inevitable, especially around low credibility data points. Consequently, smoothing results based on high credibility data points is often required. To ensure that results make actuarial sense (e.g., rising mortality rates with age), the actuary may interpolate between two points on a volatile interval. Additional adjustments can be made to include or exclude a block of business, or to reflect the impact of an external factor or another event that has affected the experience in the past or has the potential of affecting it in the future. Communication is important at this step, as business-unit actuaries, the corporate function, underwriting and claims departments all need to agree on any manual adjustments to be made to the study output to create the adjusted study results. Actuarial experience and judgment carry much weight at this stage. Adjustments for external factors, incurred but not reported (IBNR)/in course of settlement (ICOS), smoothing, and trending are only a subset of the potential modifications that can be made to study output. The process of making manual study adjustments is an iterative process, as experience movement is analyzed as each individual adjustment is made. Attribution analysis should be conducted and the impact of each adjustment should be documented in the final report, along with the reason for the adjustment.

The chart below presents an illustrative example of an unadjusted study output curve and the same curve following a number of manual adjustments. While illustrative, this chart showcases the need to apply manual adjustments, such as smoothing, to the study output.

Validate results and produce report

Before publishing experience study conclusions and recommendations, it is important to validate the study results. An appropriately validated study lends reliability and credibility to the study results. Some of the most common validation techniques include the methods below:

1. Reconciling study inputs and outputs to control totals / external sources—The actuary should obtain policy exhibits or inforce reports to compare to exposure amounts. Similarly, claims reports can be obtained for comparison to actual claims in the study output. The comparison should be done by count and by amount. This validation is meant to catch incorrect exposure calculations and data defects.
2. Sampling individual records and reproducing study engine output from first principles—Calculations can be set up in a spreadsheet and compared to records in the experience study engine. This validation tests that the experience study engine performs calculations as expected.
3. Analytical review of mortality rates—There are many possibilities to validate the study results through study variable relationships. The actuary may validate that



smoker mortality rates are higher than non-smoker mortality rates, all else kept constant. The actuary could also check whether male rates are higher than female rates and that the rates increase with age. If the expected relationships do not hold, it may be a sign that further investigation is warranted.

Once the experience study results are validated, a findings and recommendations report should be produced. The report should document the study methodology, process, assumptions used, manual adjustments, and other components of the study in detail. Proposed mortality assumptions should be included in the documentation, along with any additional considerations or caveats for using these assumptions in the future.

Additional considerations

While this article describes the overall experience study process, we would likely need to write a book to provide an exhaustive and complete guide for conducting an end-to-end experience study. Nevertheless, additional considerations that we thought were important are included in the sections below. In addition to the items outlined below, applicable Actuarial Standards of Practice (ASOPs) should be used as guiding principles for experience study projects.

IBNR and ICOS

A company's incurred but not reported (IBNR) run-off period will vary with claims practices, administrative capabilities, reporting frequency, and other factors. In order to determine the additional anticipated experience resulting from claims that have not yet been reported, an IBNR study should be conducted. The IBNR study is a study of time lags between incurred claim dates and reported claim dates. Following this study, a company should be able to estimate additional claims (count and dollar amount) that occurred but were not reported during the experience study period. The resulting IBNR estimates can be added to the actual claims to adjust for additional claims to be reported for the relevant study period following the study cut-off date. Recent experience should be considered more reliable, as IBNR claims typically show a decreasing trend over time. As administrative and reporting processes within the company improve, the IBNR run-off period will likely shorten. However, in some extreme scenarios, for instance disability income business with an elimination period of 730 days, the IBNR run-off period can extend to several years. IBNR could also be seasonal or cyclical (for instance, claim reporting slows down in December and January as claim administrators are on holiday breaks).

If the typical reporting lag is not particularly lengthy, there is another approach to treat IBNR. The actuary can wait to start the study until the likely IBNR claims are at a negligible level. For example, assume that the actuary was completing a study on the experience for calendar year 2012. If the actuary commenced the study work on Jan. 15, 2013, there would probably be material IBNR claims for policies with dates of death in 2012. If the actuary waited until June 30, 2013 to begin work on the study, the IBNR for policies with dates of death in 2012 would probably be inconsiderable, although the actuary may still choose to make a small IBNR adjustment within the study. The approach of waiting a length of time before commencing the study should be used with caution if there is a sizeable risk of material claims yet to be reported when the study is finally commenced.

In course of settlement (ICOS) claims are claims that are open at the time of the study, but are not yet paid. Those claims could include claims in review, claims in litigation, claims that were put on hold, and other similar circumstances. In certain instances, these claims may be administered outside of the system and would therefore need to be retrieved from the claims department's working files. Since ICOS experience is typically less significant than IBNR, an extensive study may not be necessary for these claims. A simplified solution could entail derivation of a flat multiple from the company's recent experience. This multiple would be applied to open claims to derive the portion of open claims likely to be paid. The actuary should be careful to not double-count open claims as both IBNR and ICOS experience.

It is good practice to summarize study results with and without late reported experience. This would highlight certain risks of late reported experience, improve the decision-making process, and add value to the study as a whole.

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External factors

External factors are typically understood to be factors that drive change in the company's experience, but are not related to the organic operations of the company's business. These factors include changes in the competitive environment, impacts of new state and federal regulations, the purchase and sale of blocks of business, and market movements. An increase in unemployment, for instance, may have an effect on the company's disability insurance block, while a natural disaster may affect the experience of a life insurance portfolio.

Since there is no defined methodology around contemplating external factors, the actuary has significant room for judgment when it comes to identifying these factors and measuring their impact on the experience. Additional uncertainty arises around the impact of these factors on a company's business in future years. Some actuaries see external factor analysis as redundant when the study period spans far enough back to account for experience fluctuation due to various external factors. For example, a significantly long study period may capture the full iteration of an economic cycle. Other actuaries are of the opinion that shocks resulting from external factors should be applied on top of baseline best estimate assumptions and therefore need to be developed independently. It is often difficult to isolate the external factor impact on experience, as several factors affect experience in tandem. Recursive impact testing would need to be conducted by adjusting each of the factors, one at a time, and analyzing the impact of the change on the experience. Generalized linear models and other advanced statistical techniques may be utilized to dissect the experience into drivers of change.

Technology

The experience study technology selection process should be carried out at the initial stages of the study. Factors to be considered in this process include costs, benefits, resources needs, ease of use, complexity, efficiency, adaptability, internal training needs, and the support needed from external consultants. Companies often revert to the MS Office suite components for their experience study needs by using Access as a data repository and Excel as the front-end reporting platform. SQL Server software has become a popular choice for analysis, especially as the volume of experience data increases. Technology vendors, who understand the need for governance and consistency in experience study methodologies, have been using SQL Server technology to build "out of the box" platforms for experience analysis. Yet another application that is commonly used for experience studies is SAS. SAS has the ability to manage and process large volumes of records fairly rapidly with the benefits of allowing the user to conduct further statistical analysis on the data.

Conclusion

Experience study work is largely data and process oriented in nature and comes with a healthy dose of design, analysis, and results interpretation. There are many considerations—of which this article certainly does not provide an exhaustive list—that need to be reflected in the experience study process. Actuaries should spend time understanding patterns in experience and validating study results. Keeping open communication lines with other key functions within the company will improve the experience study process. The insights learned from the analysis of experience study output can inform good decision-making in the setting of assumptions and are equally applicable to actuaries working in pricing, valuation, or risk management capacities.

The views expressed herein are those of the authors and do not necessarily reflect the views of their respective organizations. □