

The Future of Historic Studies

THE LIFE OF AN ACTUARY IS INTROSPECTIVE, retrospective, and prospective in a seemingly continuous cycle. A typical actuary looks at historic information, makes assumptions about trends in this historic information, and uses these assumptions to predict what will happen in the future. As the future becomes the present and then the past, the new data are added to the experience and the study is repeated. The theory is that, over time, the future predictions become more accurate and that better decisions can be made based on these predictions.

The typical method of presenting results from such a study is through tables and charts that show the results (outputs) against the inputs—the most common being “actual” vs. “expected.” (More about this simple method later.)

In the future, actuaries will need to move away from these simple types of tables and charts that present results but don’t really explain them. Companies are starting to ask different questions. No more are answers to questions such as, “Are the results as expected?” adequate. Companies are starting to go further and ask, “Why are the results different from expected?” and “What can we do about it?” or “How can we profit from this?” or even “What impact will mortality have on our new Earnings at Risk measure?”

This article recaps the traditional method actuaries have been using before moving on to techniques that can provide answers to some of these other, harder questions. We concentrate on life insurance mortality to help illustrate the possibility of a paradigm shift. We could have focused on auto claim frequency and severity, positive responses from direct-mail campaigns, or fraudulent claim detection as well.

Traditional Methods

Life actuaries measure mortality by directly calculating deaths divided by exposure or by comparing the number of people who actually die each year with the number of people who are expected to die each year. The expected number of deaths is usually obtained from a mortality table where the mortality rate (the probability of dying) changes with age, sex, and smoker status. If the chance of dying is 0.7 percent for, say, a male aged 30, and the study contains

FIGURE 1. Actual v. Expected Mortality

Age	Smoker	Standard	Preferred	Super Preferred	Summary
11–20	2.90	0.93	0.75	0.62	1.18
21–30	1.15	1.20	1.06	0.59	1.09
31–40	1.27	1.01	0.75	1.02	0.99
41–50	1.29	1.02	0.96	0.75	1.02
51–60	1.49	1.07	0.95	0.70	1.07
61–70	1.48	1.04	0.90	0.76	1.05
71–80	1.42	1.08	0.88	0.81	1.06
81–90	1.53	1.06	0.85	0.80	1.06
Summary	1.47	1.06	0.89	0.78	1.05

30,000 such people, then the expected number of deaths is 30,000 x 0.7 percent, or 210. We then tally up the actual deaths from the 30,000. Let’s say we get a total of 195 people.

The last step is to compare the actual number of deaths (195) with the expected number of deaths (210) and express that as a percentage or ratio: actual vs. expected or A/E. In this case, the ratio would be 0.93 (195/210). A number greater than 1.00 would show that actual mortality was worse or higher than expected. A number less than 1.00 would show that actual mortality was better or lower than expected. The math is slightly more complicated than the above, but that’s the basic theory.

Figure 1 and Figure 2 show the typical A/E mortality output from a fictitious study of mortality. The key inputs or independent factors are:

- Sex (male / female)
- Age band (11-20, 21-30, 31-40, etc.)
- Underwriting group (smoker, standard, preferred, super preferred)

Figure 1 and Figure 2 show that the overall actual mortality is 5 percent higher than expected, an A/E factor of

TIMOTHY J. PRATT is based in the New York practice office of Deloitte Consulting, LLP. He can be reached at timpratt@deloitte.com. DAVID M. WALCZAK is based in the Minneapolis practice office of Deloitte Consulting, LLP. He can be reached at dwalczak@deloitte.com.

1.05. It also shows that while there is some variation by age band, there is quite a lot of variation by underwriting group. In fact, it shows that the mortality for the “super preferred” underwriting group was worse than the mortality for the “preferred” underwriting group in the 31-40 age band. This is contrary to the expectations of the underwriters who categorize lives into groups based on their perceived mortality risk. The underwriters would rate “super preferred” lives as being an even better mortality risk than the “preferred” group.

The observed mortality for age band 31-40 between the “preferred” and “super preferred” underwriting groups raises some serious questions, namely:

- Were the underwriting decisions valid?
- Can we really separate lives into underwriting groups this granularly?
- Are our “super preferred” and “preferred” mortality expectations appropriate?

■ Are these results a statistical fluctuation?

The answers to some of these questions are critical to the profitable future of a life insurance company, particularly the second and third. However, the possibility that these results are purely a statistical fluctuation means that the other questions are meaningless. This quandary can leave management in a bind. Do we need to take action? Do we wait for further information? Can we afford to wait for further information?

The answers to these sorts of questions can't be found in the traditional life insurance experience studies that only compare actual with expected. The answers lie in looking farther afield for models that cater to statistical fluctuation.

Advanced Methods

Property and casualty actuaries have been using a statistical tool called Generalized

Linear Modeling (GLM) that caters to statistical fluctuation as well as to independent variable interactions.

A GLM statistical model was fitted to the observed mortality to test the interaction of the key inputs or independent factors, namely:

- Sex (male/female)
- Age band (11-20, 21-30, 31-40, etc.)
- Underwriting group (smoker, standard, preferred, super preferred)

Figure 3 also includes a factor for the amount in force band (SI for sum insured). The table shows that there is a statistically significant mortality variation by underwriting group. Models of this type test the null hypothesis that the variable isn't having an influence on mortality metrics. The result for underwriting group is that there is a 0.0 percent probability that underwriting group is not an influence on mortality. In other words, it's a strong influence.



JACOBSON

Actuarial Talent-Driven Results.

Celebrating 35 Years of Service
 actuarial recruiting
 actuarial executive search
 actuarial consulting services

FEATURED OPPORTUNITIES - Visit our website for a complete listing of actuarial opportunities.

VICE PRESIDENT/CHIEF ACTUARY

A+ rated, leading specialty insurer that sets the standard for innovative products & services seeks a high-profile, strategic & results-driven business leader to join their executive team. A forward-thinking FCAS/MAAA with 15+ years of experience and a broad-based commercial background ideal. Superior expertise in ERM, product management, financial modeling, M&A analysis and staff development is key to success. For consideration, please contact Nida Osman or Margaret Resce Milkint. Retained Search.

DIRECTOR - ACTUARIAL SERVICES

Highly visible role will oversee all of this healthcare organization's actuarial functions: pricing & product development; risk contracting; financial reporting; and regulatory issues. This ASA/FSA with 10+ years of healthcare/managed care experience (preferably with government programs) will offer actuarial analysis & recommendations to senior management. Please contact David Ueki for more details or immediate consideration.

FINANCIAL REPORTING ACTUARY

Become the close advisor to this global financial services firm's senior management to develop a new rules-based economic capital methodology for their investment management arm. Evaluate asset risk exposures & recommend changes in models & principles; develop hedging & optimization strategies for managing MVaR; and quantify overall impacts on investment income. FSA/CFAs preferred; those with 7-10 years of asset experience considered. Contact Mary Kilkenny for more about this high profile role.

EXECUTIVE DIRECTOR

Large A++ rated niche insurer providing life, health, & property coverage seeks a skilled ASA to FSA for this Executive Director role within their newly-created internal consulting operation. Strong ALM, risk management, and/or modeling experience ideal; life/annuity model development expertise, a plus. Responsibilities include model evaluation, new model development & implementation, management reporting, and special projects. Interested candidates should contact Amy Auten.

ASSISTANT VICE PRESIDENT

As AVP for the personal lines area of this fast growing company, you will be responsible for personal auto pricing analyses, external rate filings, and management of a staff of analysts. ACAS/FCAS with 5+ years of pricing experience and the ability to communicate with management and make rate change proposals ideal. Supervisory experience desired. For immediate consideration, please contact David Ueki.

INTERIM LIFE ACTUARIAL CONSULTANTS

Wide spectrum of life actuarial projects now available, including pricing of group & individual life and disability products; financial reporting; valuation; and modeling. Expertise with various commercially available software, a plus. Most projects involve some travel, all-expenses-paid with competitive compensation. Many of the actuaries who work with us are independent consultants to fill in gaps in their schedule or are in-between positions. Interested parties, please contact Antonette Rabor for more information.

Interested candidates, please send resumes to actuarial@jacobsononline.com. To learn about additional opportunities, visit our website or contact David Ueki. If you are interested in consulting-based projects, please contact Antonette Rabor.

OFFICES NATIONWIDE

WWW.JACOBSONONLINE.COM

TEL (800) 466-1578

FIGURE 2. Actual v. Expected Mortality

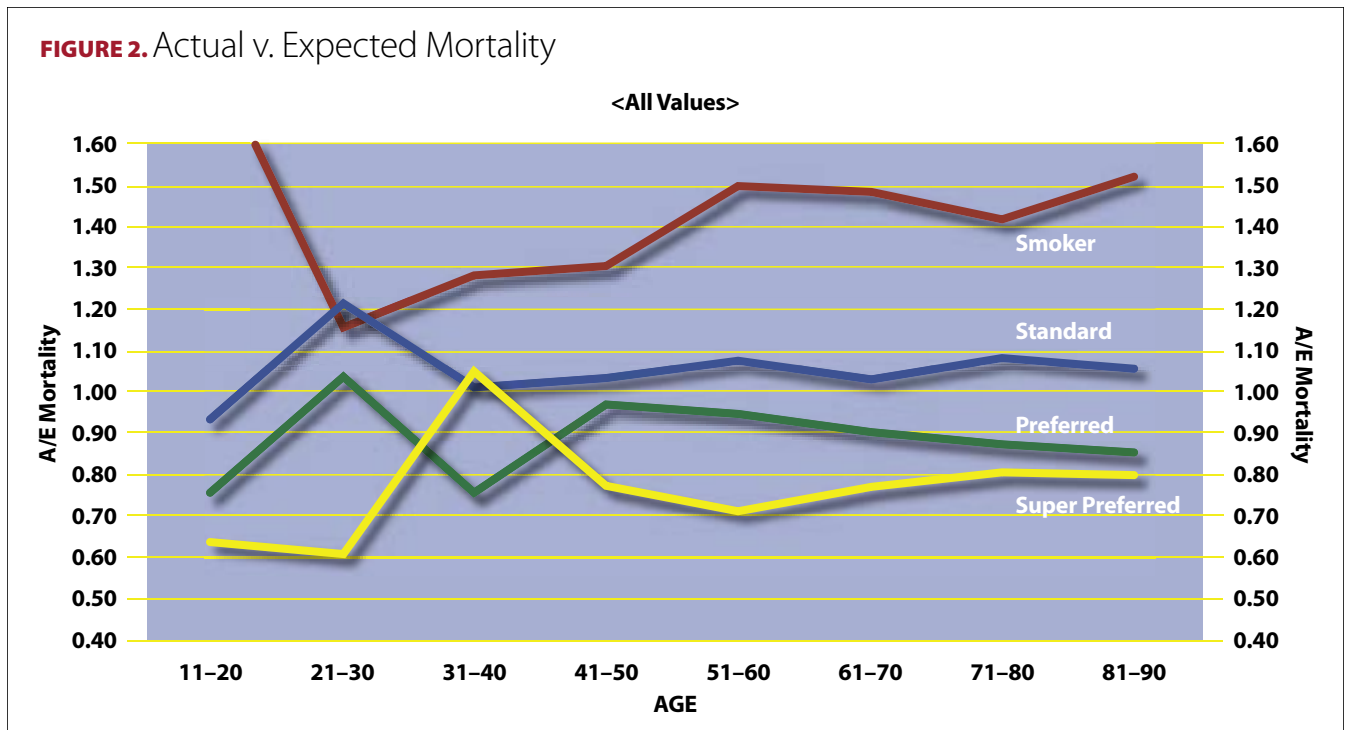


FIGURE 3. GLM Statistical Model Output

Variable	Degrees of Freedom	Chi Square	Probability >Chi Square
Age	79	0.292	18.23%
Sex	1	0.292	58.89%
Amount Inforce Band	18	13.691	74.9%
Underwriting Group	3	427.969	0.0%

This table (Fig. 3) also shows that age band, sex, and amount inforce band aren't statistically significant when comparing the expected mortality with the actual mortality because the probability exceeds a suitable threshold, typically 5 percent. Effectively, this means that, for these three factors, there is no statistical difference between the expected mortality and the actual mortality.

Furthermore, GLMs give results for individual items within the independent variables. The following chart (Fig. 4) shows the statistical parameters for the underwriting group. The columns show frequency (i.e., count) using the right-hand axis. The lines show the estimated param-

eter as well as the 5 percent and 95 percent confidence intervals (left-hand axis).

The model results showed that the mortality was 106.1 percent worse than expected overall after adjusting for the effect of the underwriting group. The impact of the various underwriting groups, relative to the standard underwriting group, was:

- Smoker, 138.1 percent relative or 146.5 percent in total
- Standard, 100.0 percent relative or 106.1 percent in total
- Preferred, 83.5 percent relative or 88.6 percent in total
- Super preferred, 73.6 percent relative or 78.1 percent in total

Conclusion

To summarize, the expected mortality table used captures the actual underlying mortality trends for age band, sex, and amount inforce band. However, it doesn't capture the actual underlying mortality for underwriting group. The current version of the GLM model suggests the use of a scalar to adjust the expected mortality for the underwriting group.

A recent study ("1995-2000 Individual Life Experience Report") of mortality can be found on the Society of Actuaries website: <http://www.soa.org/ccm/content/research-publications/experience-studies-tools/1995-2000-individual-life-experience-report/>

It would have been possible for the report authors to use GLM in their conclusions to (hypothetically) consider:

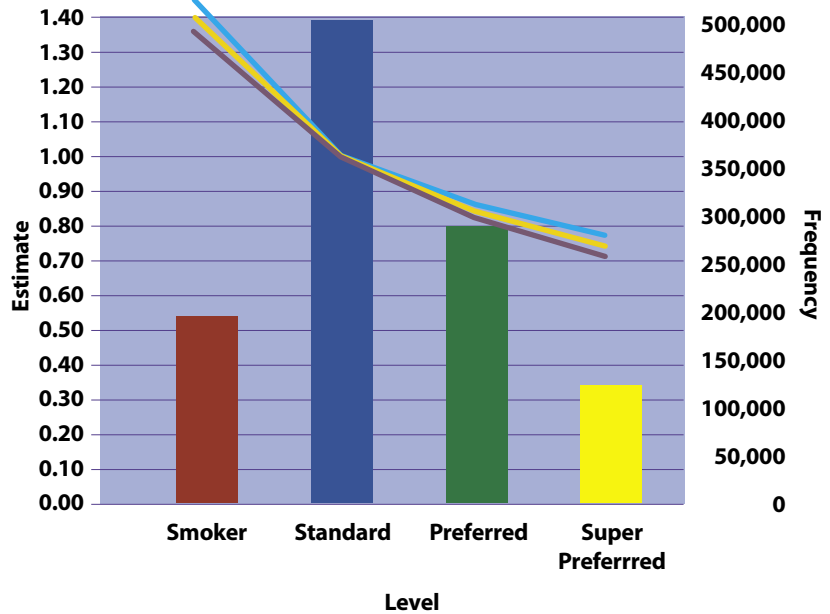
- Does the select period wear off or need more smoothing based on the type of underwriting performed?
- Are the actual/expected ratios more credible for certain categories when broken down by other categories?
- Is smoker mortality becoming more or less credible when drilled down to older

age categories?

Given more information about the data, it would be possible for a company's experience actuary to better adapt the study for pricing or for making financial reporting assumptions as well.

The analysis of past performance needs to move away from the simple, linear methods (read "actual vs. expected") to the more complicated but richer, multi-dimensional methods (GLMs). The once-hidden messages in the historic data need to be extracted and acted on. Subsequently, the opportunity to provide additional findings, answer tougher questions, and greatly assist insurance company management in differentiating the company in the modern marketplace should get the experience actuary an invitation to be a speaker at an SOA Futurism Section meeting. ●

FIGURE 4. Statistical Parameters for the Underwriting Group



Let TAI streamline your Reinsurance Reporting!



We lead the pack when it comes to providing life companies with fast, efficient and powerful solutions to their reinsurance administration needs.



Life Reinsurance Systems

10727 Winterset Drive, Orland Park, IL 60467

708/403-7775 • Fax 708/403-7801 • info@taire.com • www.taire.com

Leading-Edge Automated Administration Systems • Auditing Services • Administrative Consulting