

Credibility in Life Insurance Modeling

Overview

In much of the work that life actuaries do, there are the concepts of using relevant and credible data. This has come to the forefront in work being done on principle-based reserving (PBR) assumptions—when actuaries determine the baseline assumptions to be used, the National Association of Insurance Commissioners (NAIC) Valuation Manual states that relevant and credible experience should be used, with margins added (or subtracted) to reflect the degrees of uncertainty. This same method is also present in other actuarial work, such as liquidity and stress testing, asset adequacy testing, and product profitability testing.

It can be difficult to determine what relevant and credible experience is. For a hypothetical example, a company may have a mortality study with 10,000 deaths, which some may feel is fully credible. But, although the block is fully credible in the aggregate, it may be that all of the business is in duration 1-15 or all in attained ages less than age 90, so the credibility outside those ranges may be nil.

In addition, when reviewing the data, one may discover that the data includes both simplified and fully underwritten policies, and different eras where the underwriting standards have changed. Also, the data itself covers various ages, sexes, durations, and risk classes of policyholders (non-smoker, smoker, preferred, etc.) So, for example, is the mortality rate in policy duration 10 for a 62-year-old smoker still credible? Similar issues could occur for other assumptions such as lapses, morbidity, and premium persistency.

The aggregation / granularity consideration is critical. On one hand, slicing the data too finely can be problematic because each slice may not be statistically credible. However, aggregating several blocks together (on the assumption that more data is always better) may lose sight of underlying differences.

If using an industry study, similar issues can also occur as to whether the data in the study is fully relevant and credible for a particular company's block of business.

This discussion brief does not provide conclusions on what assumptions an actuary should use in various situations.

However, our committee believes that it would be helpful for the actuary to develop a list of useful resources with respect to credibility.



Items to Consider When Determining Relevant and Credible Experience

When considering relevant and credible experience, actuaries should be aware of the actuarial standards of practice (ASOPs) which apply. The most applicable to this topic is ASOP No. 25, *Credibility Procedures*, which is discussed as Item 1 in the Sources of Information section.

Applicable laws and regulations should also be reviewed. For PBR work, this is the PBR section of the NAIC's Valuation Manual, which is discussed as Item 2 of the Sources of Information. Note that this document is also a source of information for considerations on credibility of assumptions in other types of modeling, such as asset adequacy testing.

One issue that actuaries may be cognizant of is that “industry data” does not automatically mean that it is fully relevant to a particular company—the industry data would need to have characteristics similar to the company's data. This is one of the issues discussed in the American Academy of Actuaries' Life Valuation Subcommittee's *Credibility Practice Note* in July 2008. Merging company and industry data is also discussed in this practice note. More comments on this are in Item 3 of the Sources of Information.

Various actuarial papers and articles focus on one or more actuarial assumptions. These papers are discussed as Item 4 of the Sources of Information. The first paper listed in Item 4 is a Canadian Institute of Actuaries (CIA)/Society of Actuaries (SOA) paper that concentrates on credibility on mortality and lapse data. A paper specifically on setting is the Canadian Institute of Actuaries' Educational Note, *Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies*. This is also mentioned in Item 4 of the Source of Information.

There is also an issue as to how to handle data outliers—e.g., some may feel that deaths due to COVID-19, particularly before vaccinations were available, could be considered outliers. There is a question as to how these outliers should be addressed. There are two sources in Item 5 on COVID-19 that give some consideration as to how outliers should be handled.

There are several papers that have additional information regarding the math behind the determination of the level of credibility. It is useful to remember that requirements for full classical credibility when targeting a p% chance of being within k% of the underlying rate (when the rate is being estimated on a counts basis). The p% and k% are actuarial judgments, and the formula technically doesn't hold on an amounts basis although one can make adjustments. Simple

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thresholds may not be directly applicable when behavior isn't so statistical—e.g., mortality vs. some forms of policyholder behavior. In particular, if the assumption is a dynamic formula that varies with markets or there are conditions (e.g., product, regulatory, claims management changes; trends) that may make the underlying data less relevant even though it might be credible based on the volume of data alone. Judgment and professionalism are always important vs. simple bright-line tests or hard and fast rules. Three papers that are of interest here include an SOA paper on the study of credibility methods applied to life, health, and pension issues; a paper specifically on the credibility methods used for mortality studies, and a third on imprecise credibility theory. These three papers are discussed in Item 6 of the Sources of Information.

Sources of Information

Actuarial Standard of Practice No. 25, *Credibility Procedures*

All actuaries are subject to actuarial standards of practice (ASOPs); especially germane to this discussion is ASOP No. 25, *Credibility Procedures*. This ASOP may be considered required reading for all those dealing with the subject of credibility. It also has a section on the actuary disclosing credibility procedures used in actuarial communications, including any material changes from prior credibility procedures.

Source of Information:

<http://www.actuarialstandardsboard.org/asops/credibility-procedures-3/>

Valuation Manual

For PBR testing, the Valuation Manual provides certain instructions. For example, Section 9 of the Valuation Manual states that “for risk factors (such as mortality) to which statistically credibility theory may be appropriately applied, the company shall establish anticipated experience assumptions for the risk factor by combining relevant and credible company experience with industry experience data, tables or other applicable data in a manner that is consistent with credibility theory and accepted actual practice.” For mortality, the Valuation Manual states that credibility of company mortality experience be determined using the Limited Fluctuation Method or Bühlmann Empirical Bayesian Method by amount, with the minimum probability being 96% with an error margin of no more than 5%. As the NAIC Valuation Manual provides the minimum standard for developing PBR reserves, anything in the manual on credibility needs to be followed when developing PBR reserves.

Source of Information:

https://content.naic.org/sites/default/files/pbr_data_valuation_manual_future_edition.pdf

Credibility Practice Note

The *Credibility Practice Note*, published by American Academy of Actuaries' (then) Life Valuation Subcommittee in July 2008, is a practical source of information on credibility. It gives examples of regulatory guidance on credibility standards used by state regulators, and examples of industry practice on credibility. It is also a source of information on further papers on credibility.

Source of Information:

https://www.actuary.org/sites/default/files/files/publications/Practice_note_on_applying_credibility_theory_july2008.pdf

Actuarial Papers on Credibility With Regard to Setting Life Actuarial Assumptions

The Canadian Institute of Actuaries and the Society of Actuaries published a research report on the application of credibility theory in the Canadian life insurance industry. This paper was published in November 2019. The paper surveyed what Canadian companies do with regard to credibility in mortality and lapse assumptions. It discusses what the parties determined what counted as full credibility, and how they weighted company experience when it was not 100% credible (e.g., for lapse, the weight of the company experience is the square root of $n/3,007$, with n being the number of claims for the company).

Another source of information is the Canadian Institute of Actuaries Educational Note, *Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies*. This note, written in 2002, is a superb paper on what to consider with respect to setting mortality.

Sources of Information:

<https://www.soa.org/resources/research-reports/2019/application-credibility-theory/>

<https://www.cia-ica.ca/docs/default-source/2002/202037e.pdf>

How to Consider Outliers

The Academy of Actuaries' Life Experience Committee specifically looked at the issue of outliers with regard to COVID-19. The Academy published a discussion brief and Sources of Information paper on this subject. The discussion paper gives an idea of what to consider with respect to items that may be considered outliers.

Sources of Information:

https://www.actuary.org/sites/default/files/2022-06/Reflecting_COVID-19_Life_Insurance_Mortality_Brief_0.pdf

<https://www.actuary.org/sites/default/files/2022-06/Sources%20of%20Information%20on%20COVID-19%20in%20Life%20Insurance%20Mortality.pdf>

Actuarial Papers on Credibility Theory

A source of information from the Society of Actuaries is a study of credibility methods applied to life, health, and pensions. This paper discusses the theory of credibility methodology and provides some examples on methods. This study was published in February 2019.

Another paper is called *Credibility Methods for Individual Life Insurance*. It concentrates on the limited fluctuation and the greatest accuracy (Bühlmann) methods of credibility particularly in relation to life insurance mortality was published by MPDI (Multidisciplinary Digital Institute, a publisher of open-access scientific journals.)

The Institute and Faculty of Actuaries published a paper called *Imprecise Credibility Theory* in April 2021. This paper acknowledges the imprecision of measurements in the credibility models, but also recognizes the need of an easy-to-compute credibility estimator.

Sources of Information:

<https://www.soa.org/globalassets/assets/files/resources/tables-calcs-tools/credibility-methods-life-health-pensions.pdf>

<https://pdfs.semanticscholar.org/8294/823da366cda2b48945faa08e22c8a1aae1a9.pdf>

https://www.cambridge.org/core/services/aop-cambridge-core/content/view/E2D5CB12B95B048D18FF427E105C9D15/S1748499521000117a.pdf/imprecise_credibility_theory.pdf

Summary

There is no magic to obtaining fully credible answers to predict future assumptions needed in life insurance modeling. However, actuaries understand the strengths and weaknesses of various credibility models that are used in setting the assumptions. Depending on the use of the models, margins should be set in part to reflect the limitations on accuracy in the models.

If you have any feedback on this document, please contact the Academy's life policy analyst, Amanda Barry-Moilanen, at barrymoilanen@actuary.org.

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