Risk Assessments

MORBIDITY, MORTALITY, AND THE C-2 RISK

Michael Cowell, FSA

Ask the average person on the street why insurance companies classify risk, and you're likely to get a blank stare in response. Even if the question is somewhat understood by those who are more knowledgeable about insurance, the response is likely to be along the line of "so that companies can exclude those people who are going to have claims." Given the kind of intense criticism that insurance companies have been subjected to lately, including from high places in Washington, that kind of response coming from the general public is hardly surprising.

For those of us at the other end of the risk classification pipeline – underwriters, medical directors, actuaries – this constant bashing for doing what we believe follows sound insurance principles, seems a little unfair. But given the inadequate job that the industry has done to educate the public about how their insurance works, should we really be surprised that we have reached this seeming impasse?

In this article, I discuss the rationale for risk classification from the perspective of basic insurance principles and the related subject of risk capital. I will attempt to show the significance of these fundamental concepts for medical underwriting, and briefly discuss the other major aspects of risk that must be taken into account in insurance management.

In basic insurance courses, one quickly grasps that the impetus for common insurances is that most people are risk averse. Insurance is one way to afford risk relief. Given a choice, most people prefer the certainty of a small periodic expense – insurance premiums – to the uncertainty of a sudden loss that could be catastrophic and financially ruinous. Economists describe this phenomenon in terms of utility theory, an arcane science unto itself, but most people who have studied insurance basics seem to accept the concept as intuitive.

VP and Corporate Affairs Actuary, UNUM Life Insurance Company, Portland, Maine

But what kind of risk is *insurable* risk? Actuaries have identified a number of principles that need to be followed in order for risk relief to be provided in a financially sound insurance process.

- For an individual risk, the probability of a claim occurring should be *small.* ("Small" is not defined, but typically anything in the range of a few percentage points a year would be acceptably small for most insurance arrangements.

- The event should be *random.* The insured should have no control – or minimal control – over the event that triggers a claim.

- There should be *equivalent likelihood of the event* occurring, for persons of comparable risk. The chances of a claim occurring should be as close to equal as possible for all those insured at the same cost.

- There should be *large numbers insured.* (Again, "large" isn't specified but, as we shall see, depending on the nature of the risk, numbers in the thousands or millions help to make the cost of the insurance more affordable.)

- This brings us to the last factor – the one rooted in utility theory – *affordable cost.* The cost of insuring a risk should be affordable as contrasted with not insuring it.

Where does medical underwriting fit into this picture of risk management? It is clearly of central importance to the first three of the principles outlined above.

First, people applying for insurance should not be doing so if the principal reason is that they expect to present a claim. The medical underwriter is trained to sort out applications that have evidence of such medical "antiselection." The vast arrays of clinical and diagnostic information available to the trained medical underwriter have greatly reduced this risk for the insurance company equipped to use them.

Second, insurance is intended to protect against unscheduled events typically of a nature that, if not catastrophic, are likely to bring serious financial consequences on the insureds or their beneficiaries. In life insurance, with the rare exception of suicide, this principle is generally adhered to without question. In disability insurance, there are potential secondary gain issues and unfortunate examples of insureds benefiting from seeking to be judged as "disabled." Here sound medical underwriting, together with thorough financial underwriting, may be even more important than in life insurance. It is often said that in life insurance, life continuance itself is the risk being insured; in disability insurance it is in some respects the applicant's work ethic.

The third principle is one that brings the medical underwriting and actuarial communities together. Over the past several centuries, mathematicians and demographers (and in North America since the mid 1800s, insurance medical directors and actuaries), have worked together to create tables of mortality that are reasonably predictive of the kind of claims experience expected from insuring sufficiently large numbers of people of similar *a priori* risk characteristics.

Over the period from about 1860 to date, we have seen the development of such well known tables as the American Experience, the American Men, the 1941 CSO (Commissioners Standard Ordinary), the 1958 CSO and, most recently, the 1980 CSO. In addition, there have been numerous tables developed for group life insurance, annuities and disability insurance.

Since the early part of the 19th century, actuaries have taken such tables and fitted them to mathematical models of mortality. Most famous is the work of Benjamin Gompertz who, in 1825, presented his paper to the Royal Society of London on "The Nature of the Function Expressive of the Law of Human Mortality."

In this paper, Gompertz showed that mortality rates could be expressed as an exponential function of age in the form:

$$\mu_x = B\, c^x$$

In 1860, William Makeham, an actuary, refined this formula by adding a constant, to produce:

$$\mu_x = A + B\, c^x$$

Most life tables are now routinely fitted to modifications of Gompertz's and Makeham's formulas that reproduce the underlying mortality with remarkable accuracy across a wide range of ages. Further discussion of such analysis is beyond the scope of this article, but readers interested in probing this process further may wish to read the Society of Actuaries text "Actuarial Mathematics"[1] Discussions of mortality modelling are also available in other references.[2-5]

The emphasis throughout the process of quantifying mortality and morbidity is to classify insurance risks according to their likelihood of resulting in a claim. Failure to observe this principle usually results in the insurance process unravelling. This was seen in practice in the "assessment societies" of the 1800s, in which unhealthy people stayed in the plan, while the healthy ones left to find less expensive insurance elsewhere.

More recently, we have seen the difficulties that a number of insurers have had with renewable term policies if the initial medical underwriting is not adequately thorough. The increasingly unhealthy lives renew, while the healthy ones reapply for insurance at lower rates than their attained-age renewal schedule. Less obvious are such subtle shifts over time as health habits that leave one or more sub-groups of the insured or insurable public in worse health than the others.

One such example with which the author has had considerable experience is the effect on life insurance mortality resulting from the major shift in smoking habits in the 1960s, following the publication of the Surgeon General's first major report on "Smoking and Health." Prior to this time, no major company differentiated its premium rates between smokers and non smokers.

This Report, however, led to a major decline in smoking in the US, and companies began to exploit the health advantages by offering lower premiums to non smokers for the same coverage. Within a few years, they were able to confirm that the relative mortality differences between smokers and non smokers in the insured population were as great as – if not even greater than – those in the general population. As a result, few major life insurers today offer life insurance to smokers at the same rate as non smokers. The excess mortality of the smokers is known, *a priori,* to be too significant for these two groups to be classified together.

The "law of large numbers" is a fundamental tenet of statisticians and actuaries; it simply asserts that after a sufficiently large number of statistical trials – and the exposure of insured lives to the risk of mortality fits this *stochastic* model perfectly – the claim rate will settle down to some statistical average. This can be illustrated in a simple example of insuring successively larger numbers of lives, all with the same expectation of claim in the same period.

Let us assume that the expected mortality for any one person is 1% in the period. (This rate – 10 per thousand

– is by the way, approximately the annual mortality rate for insured males age 55.) The following table shows the substantial decline in the *standard deviation* of claims resulting from pure-chance statistical fluctuation arising from successive increases in the numbers insured:

Number Insured	*Expected Claims*	*Standard Deviation of Expected Claims*	*Standard Deviation of Claims as a Percentage of Expected Claims*
100	1	0.995	99.5%
1,000	10	3.146	31.5%
10,000	100	9.95	9.9%
100,000	1,000	31.46	3.1%
1,000,000	10,000	99.5	1.0%
10,000,000	100,000	314.6	0.3%

Since the random fluctuation in claims incidence is one of the factors that determine risk capital requirements, and hence the price of the product, it is clearly to the advantage of the insured to buy coverage from a company that can spread its risk across large numbers. Large companies can, and do, carry less risk capital per unit of premium (i.e. "reserves") than their smaller counterparts.

Other things equal – which often they aren't – it should follow that larger companies can offer insurance at lower cost to consumers. However, in the last part of this article, we'll see why this is not always the situation. The point of the last of these principles is that large or small, the insurance company must offer products to potential customers at a price that is affordable, and that is viewed by the insurance-buying public as a rational and economic alternative to self insurance.

This last reason explains why marketing plays so significant a part in the insurance scene in North America, and in those parts of the industrialized world where the insurance market can be said to have achieved its greatest maturity and efficiency. The more units of insurance sold, the less expensive it is for everyone. In the perhaps biased view of the author, efficient insurance markets exist in the US, Canada, Western Europe, Australia and, possibly, Japan, countries, not coincidentally, in which insurance medicine and medical underwriting have had their greatest development.

By now, the reader should sense the critical importance of medical underwriting to the actuary's pricing work. The actuary depends almost exclusively on the underwriter to ensure that the *patterns* of mortality and morbidity that will emerge from the latest blocks of business being written will closely match the pricing assumptions and risk models that the actuary has built into the premium and reserve processes.

This leads to the last segment of the article, the spectrum of risk that the actuary and the financial officer must consider in developing reserve and capital margins that will give management the required measure of confidence that the company will remain solvent.

In December 1992, the NAIC adopted for the first time in its more than 100-year history a set of standards for risk-based capital. These are based on the risk characteristics of the insurance policies in force and the investments backing them, and are intended to give regulators and the insured public a measure of confidence that their companies are well capitalized.

Based on the risk analysis research of the Society of Actuaries in the 1970s, the NAIC Risk Based Capital (RBC) formulas are designed to measure the four general categories of contingency to which insurance companies are exposed. These contingency risks have been classified as:

- C-1 The risk of asset default
- C-2 The risk of mispricing
- C-3 The risk that assets and liabilities are mismatched; and
- C-4 General business management (others would say mismanagement) and external (eg., political, regulatory, tax) environmental changes.

With varying degrees of scientific justification, these risks are quantified by a combination of stochastic probability and risk theoretic models. Their purpose is to determine, based on such characteristics as premium levels for various types of insurance, amounts of insurance in force, reserves and asset types, just how much capital the company needs to hold in excess of reserves so as to prevent insolvency at, for example, the 95% confidence level.

Again, a complete description of the development and implementation of the RBC process would require several articles each the length of this one. Suffice it to say that the RBC formulas adopted by the NAIC have received generally wide acceptance across the industry, and the results of applying them were reported for the first time in the 1993 statutory Annual Statements of each life and health company.

The process involves calculating a total RBC requirement, and using it as a basis of comparison for the company's actual capital and surplus, adjusted for certain miscellaneous reserves. Provided the company's adjusted capital exceeds its RBC requirement by at least 25%, the company is assumed to be adequately capitalized. At various threshold levels of increasing capital inadequacy below 125% of RBC all the way down to 35%, the commissioner

of the state of domicile is required to take regulatory action all the way from requesting a plan of action to seizure.

Since so much of what is involved in the determination of C-2 risk is a function of sound underwriting, let us close with a few observations related to risk based capital.

The risk of mispricing can arise in a number of ways. First, as discussed above, inadequate underwriting may result in a block of new policies whose inherent mortality and morbidity exceeds by more than just random fluctuations the underlying assumptions in the table that the actuary has used to price the business. For traditional business, this is essentially bad underwriting. However, this cause of missing the underlying mortality or morbidity trend is more likely to occur in offering new coverages; long term care is a good current example, in which statistics on disability on insured lives at the older ages are incomplete.

Second, the overall pattern of mortality – or, more likely, of morbidity – may be undergoing a secular or cyclical shift. With one recent exception, mortality has generally followed an improving trend for most of the 20th century. This is good news for insurance, but not so good for annuity writers, especially since so much of the mortality improvement has come at the later ages. The one exception is, of course, the HIV epidemic, and the attendant increase in deaths and disabilities from AIDS-related illnesses. Until we became aware of this epidemic, it could fairly have been classified as a C-4 risk. Once known, however, and quantifiable, it became a classic C-2 risk, and companies that did not price and underwrite for it experienced – and continue to experience – impairments to their operating profit.

So far, though, no company appears to have suffered insolvency lately as a result of C-2 risk. For the top 100 companies by size in 1992, C-2 risk under the NAIC RBC formula accounted for about 20% of total RBC, while C-1 and C-3 – the asset related risks – accounted for almost 80%. C-4 represented only a few percentage points of total risk.

Given the asset failures of the late 1980s and early 1990s, to which such prominent companies as Mutual Benefit and Executive Life fell victim, the emphasis of the NAIC on asset-related risk is not surprising. But then again, if those in our business charged with looking after the assets had been doing as good a job as the medical underwriters, with their eyes on the C-2 risk, the industry might be in a far stronger position today.

References

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