The Role of the Actuary in Insurance

Michael Hafeman

PRIMER SERIES ON INSURANCE
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NON-BANK FINANCIAL
INSTITUTIONS GROUP

GLOBAL CAPITAL MARKETS
DEVELOPMENT DEPARTMENT

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THIS ISSUE

Author ***Michael Hafeman*** consults on a variety of financial sector issues, focusing on regulation and supervision. He is a member of the Public Interest Oversight Board, which oversees the public interest activities of the International Federation of Accountants, and he has provided quality review of Insurance Core Principles assessments for the World Bank and International Monetary Fund. Recently, he has provided technical assistance to a Caribbean central bank that is assuming responsibility for insurance and pension supervision. Mr. Hafeman worked many years in management positions in the insurance industry and actuarial profession, worked as a principal at William Mercer Ltd, a partner at Morneau Sobeco/Sobeco Ernst & Young, and was the assistant superintendent at the Office of the Superintendent of Financial Institutions of Canada from 2000–03.

Series editor ***Rodolfo Wehrhahn*** is a senior insurance specialist at the World Bank. He joined the Bank in 2008 after 15 years in the private reinsurance and insurance sector and 10 years in academic research. Before joining the World Bank, he served as President of the Federation of the Interamerican Insurance Associations representing the American Council of Life Insurers. He was board member of the AEGON Insurance and Pension Companies in Mexico, and was CEO of reinsurance operations for Latin America for Munich Reinsurance and for AEGON.

For questions about this primer, or to request additional copies, please contact: insurancesector@worldbank.org.

The *Primer Series on Insurance* provides a summary overview of how the insurance industry works, the main challenges of supervision, and key product areas. The series is intended for policymakers, governmental officials, and financial sector generalists who are involved with the insurance sector. The monthly primer series, launched in February 2009 by the World Bank's Insurance Program, is written in a straightforward, non-technical style to share concepts and lessons about insurance with a broad community of non-specialists.

The Non-Bank Financial Institutions Group in the Global Capital Markets Development Department aims to promote the healthy development of insurance, housing finance, and pension markets, and to expand access to a broad spectrum of financial services among the poor. These markets provide opportunities for household investment and long-term savings, and can buffer the poor against the risks of sickness, loss of breadwinner, catastrophic events, and other misfortunes.

1818 H Street, NW
Washington, DC 20433
Internet: www.worldbank.org/nbfi
E-mail: insurancesector@worldbank.org

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What is an actuary?

Actuaries are professionals who apply mathematics to financial problems. They evaluate the financial implications of contingent events, in other words, events that are not certain to occur. They are often involved in managing the risks that can arise from undesirable contingent events. Actuaries evaluate the likelihood of future events. They also design ways to reduce the financial impact of undesirable events that do occur.

To do their work, actuaries must have a high level of technical knowledge. For example, they need to understand the nature of insurance, the risks inherent in different types of assets, the ways in which statistical models can be used, and the legal and regulatory constraints that apply to the business. They must also have good business sense, problem solving skills, and the ability to communicate effectively with others. Their work often affects many stakeholders, so they must be able to balance different interests and observe high ethical standards in doing so.

Although the actuarial profession has existed for many years, it is not a large profession and, therefore, is not well known by members of the general public. In fact, there are many countries in which no actuaries reside. Actuaries have traditionally worked primarily in the insurance and pension industries, and mostly in countries where those industries are well established. In the insurance industry, actuaries can be involved in all types of insurance: life or nonlife; and direct insurance or reinsurance. Although actuaries are often employed by

insurers, many are employed by consulting firms and provide services to more than one insurer. Some insurance actuaries work for supervisory authorities, as either employees or consultants.

Within these organizations, actuaries can fill a wide range of positions. Many actuaries work in technical roles, applying their skills to tasks such as designing new insurance products, forecasting expected rates of loss, setting premium rates, or calculating the liabilities of an insurer to its policyholders. Others apply their knowledge and experience in management positions, with responsibilities ranging from technical or operational departments, to product line management, to senior executive roles.

Basic actuarial concepts

The work of an actuary can be extremely complex and challenging. However, reduced to its basics, it often involves the application of probabilities and the time value of money through models that are designed to reasonably represent reality and assist in analyzing a particular situation. A brief introduction to these concepts can provide the context for better understanding the particular areas of work in which actuaries are involved in the insurance sector.

Probabilities

Insurance is a business that is built on probabilities. Most insurance policies protect the policyholder from the financial consequences of undesirable contingent events, such as death, fire, or accidents. However, life annuities protect against the adverse financial consequences of a desirable situation, which is the possibility that a person will run out of money because of living longer than expected. In either case, it is impossible to predict exactly what will happen with respect to a particular policyholder. However, as the number of policyholders with similar risk characteristics increases, the outcome for them as a group can be predicted with an increasing level of confidence. This predictability enables insurers to take on risks that are individually highly unpredictable, and spread the financial consequences across many policyholders through the premiums charged.

Actuaries measure the risks that are insured against to determine their probabilities of occurrence, sometimes referred to as frequency, and use these probabilities in a wide range of calculations. For example, the probabilities of persons dying at particular ages can be detailed

in a mortality table, which can be used in calculating life insurance premiums and liabilities to policyholders.

For some types of insurance, it is not enough to know the probability of an event occurring, because the financial consequences of the event could depend on its severity. For example, one motor vehicle accident might require only minor repairs to the vehicle, while another might totally destroy the vehicle and severely injure its occupants. Therefore, actuaries need to understand the costs that might be involved if an event occurs. This understanding of severity might be limited to knowing the average cost of an event or, more usefully, by estimating the probabilities that the cost of an event would exceed various levels.

The simplest approach to using probabilities is called deterministic. In this approach, the most likely frequency and severity probabilities applicable in a particular situation are used in the calculations. For example, a mortality table may indicate that the mortality rate at a particular age is 0.0025, and this rate is used in calculating the premium rate to be charged to policyholders of that age. The deterministic approach typically produces a single answer in a particular situation.

However, even with a large number of policyholders of the same age, the actual mortality rate at that age can vary from year to year. In fact, the mortality rates shown in a mortality table are not certainties, but merely the averages of probability distributions of mortality rates. The stochastic approach to using probabilities recognizes these underlying probability distributions and uses them in the calculations. This is usually done by using the probability distributions to generate many alternative scenarios of what might happen and repeating the calculations for each scenario. The stochastic approach produces a range of answers, with different probabilities attached to them.

The above discussion has focused on the probabilities directly related to the events that lead to insurance claims. However, there are many other factors that can affect the cost of an insurance policy and for which probability analysis can be useful, or even essential. Some of these relate to the behavior of policyholders. For example, a policyholder may decide to pay a premium on the policy renewal date or let the policy lapse, or a policy may provide a range of options from which a policyholder may choose at specific dates. Other factors are economic in nature, such as the investment returns that might be earned by an insurer, the expenses involved in the administration of insurance policies, and the rates at which various types of expenses might increase over time because of inflation or changes in operating efficiency.

Time value of money

In most businesses, a customer pays money to the business in exchange for a product or service that is received either immediately or shortly thereafter. The insurance business is much different, because a policyholder pays premiums in exchange for the insurer's promise to make a payment to the policyholder in the event of a claim. Claims can occur as early as the day a policy is issued or, at the other extreme, more than a century later, in the case of a life insurance policy that is issued on the life of an infant who is fortunate enough to live beyond age 100. The insurer has use of the money during the period between the time it receives premiums and the time it pays claims. The money is invested by the insurer and the income from the investments can provide some of the funds needed to pay the claims. The longer this period of time is, the more significant the effect of such investments on the cost of the insurance policy. Reflecting the financial effects of the timing of various cash inflows and outflows is referred to as recognizing the time value of money.

Actuaries incorporate the time value of money in their calculations to assess the net value of a stream of cash flows at a particular point in time. The point in time may either be now or a date in the future. Determining the value of a stream of cash flows at a date in the future involves accumulation with interest. For example, if an insurer collects a single premium of US$100 and is able to invest it at an annual rate of interest of 10% for a period of three years, and reinvests the interest it earns, it would have accumulated US$133.10 by the end of the period.[1]

Determining the present value of a stream of future cash flows involves discounting with interest. Discounting recognizes the fact that the present value of an amount of money that is to be paid or received at a future date is less than that amount. This is because a smaller amount, invested now, could earn enough interest during the period to accumulate to the amount needed in the future. Therefore, discounting with interest is much like accumulation with interest, only in reverse. For example, if an insurer expects to have to pay a claim of US$100 three years from now and could earn an annual rate of interest of 10% during that period, the present value of the claim payment is US$75.13.[2]

1. Investing US$100 for one year generates $10 of interest. Investing that US$110 for the second year generates US$11 of interest, bringing the total to US$121. Investing that US$121 for the third year generates US$12.10 of interest, bringing the final total to US$133.10. Mathematically, the calculation can be expressed as US$100 times 1.10^3.
2. The present value is calculated as US$100 divided by 1.103.

Actuarial models

Actuaries often use mathematical models in their work. Some of the models are very simple, perhaps consisting of only one mathematical formula. Other models, such as those used to price insurance products or test the capability of an insurer to withstand a range of adverse scenarios, can be extremely complex. They can incorporate many mathematical equations, involving hundreds of parameters about which assumptions must be made, and use vast quantities of data about the policies and investments of the insurer.

Many of the actuarial models are used to project cash flows of various types and calculate the present value or future values of these cash flows. The simpler models take a deterministic approach to the projections, while the most complex models may take a stochastic approach with respect to at least the most significant parameters.

Three elements are common to almost all actuarial models. The first is that they involve a methodology, in other words, an approach used by the actuary to analyze the situation. Actuarial methodologies have evolved over time, for example, to take advantage of the computational power of computers. The mathematical equations incorporated in the model will be consistent with the methodology chosen by the actuary. The second is that they require that assumptions be made about the various parameters that are reflected in the equations. The third is that they use data about the situation in the calculations. The data may be actual information about the insurance policies and investments of the insurer. However, in some cases, the data may be hypothetical information, such as a possible portfolio of investments that the actuary is testing for suitability.

Areas of actuarial work

As mentioned, actuaries are involved in many aspects of the operations of insurers. To illustrate this fact and focus attention on some of the key areas of actuarial work, it may be useful to consider a concept known as the actuarial control cycle.[3] The actuarial control cycle (figure 1) shows that, within the business environment, there are many interrelated factors that affect the ability of an insurer to generate and maintain sufficient capital to ensure that it can meet its obligations to policyholders. The diagram is circular because each element has an effect on

3. The actuarial control cycle was originally described by the Institute of Actuaries of Australia.

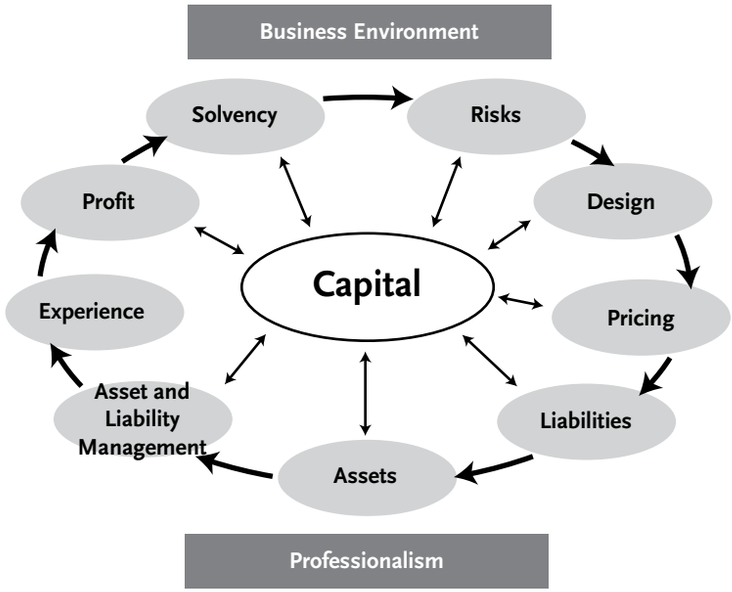

Figure 1. Actuarial control cycle

the next, and analysis of the results provides necessary input to future developments along the entire cycle. The professionalism of the actuaries involved is an essential ingredient in the successful operation of the cycle.

Starting with "risks," we will briefly examine the objectives that are relevant to each element of the actuarial control cycle, then describe the roles that actuaries play in helping to achieve those objectives.

Risks

Insurers are subject to many types of risk, not only those against which they insure policyholders, which are called underwriting risks. Other types are credit, market, liquidity, and operational risks. The objectives of an insurer are to understand the nature and extent of the risks to which it is subject and to manage those risks effectively.

Actuaries are often involved in the risk assessment process. They identify the specific risks that can affect insurers and consider the relevance of those risks to a particular insurer. They seek to quantify

the most relevant risks, and use this information to assess the potential effect of those risks on the insurer's financial situation.

Actuaries also participate in managing the risks. For example, they may determine how much risk an insurer can afford to retain on each policy, design a reinsurance program to deal with excess amounts of risk, and negotiate the terms of reinsurance contracts with the reinsurers. In recent years, a growing number of companies in a wide range of businesses have appointed chief risk officers and adopted an approach known as enterprise risk management (ERM). In the insurance business, the chief risk officer is often an actuary.

Design

Insurers seek to design products that will meet market needs. The risks insured under their products must be ones that are capable of being managed. For example, individuals might be willing to buy a product that would insure them against the risk of unemployment, but if the insurance covered situations where an individual quit voluntarily, it is unlikely that the risk could be managed by the insurer. Of course, products must also be designed to in a way that they can be priced appropriately, from the perspectives of both the insurer and its policyholders.

Actuaries often play important roles in the product design process. They assist in identifying market needs, for example, through the analysis of sales patterns, competitors' products, and social and demographic trends. They work with others, such as marketing, underwriting, and investment experts, on product design teams. Their work can involve assessing the feasibility of product design features suggested by others, as well as proposing alternatives for consideration. Actuaries are also involved in designing compensation schemes for the intermediaries that will sell the products. The compensation schemes must be attractive to the intermediaries, affordable, and provide incentives to promote the sale of high quality business.

Pricing

If an insurer is to be successful in the long term, its products must be priced adequately to produce profits. At the same time, prices must be competitive with those offered by other insurers and, for some types of products, non-insurance alternatives. Prices must be reasonable from the policyholders' perspective, being equitable among various classes

of policyholders and bearing a reasonable relationship to the benefits provided by the policy.

There are many factors that must be considered when calculating premium rates that can be expected to produce profits. The costs of the benefits provided by the product design must be estimated, including not only basic claims costs but also the potential costs of any guarantees and options provided to policyholders. Expenses must be accounted for, including commissions, underwriting costs, other policy administration costs, and overhead costs. The prices must reflect the rates of return that the insurer expects to earn on the investment of premiums, as well as expectations about the willingness of the policyholders to continue paying premiums and maintain their policies in force.

To the underlying cost factors mentioned above must be added the need to produce a reasonable profit margin. In many jurisdictions, insurers are required to maintain capital at levels that are related to the risks inherent in the policies they have underwritten. Even in the absence of such requirements, sound business practice dictates that insurers have adequate capital to support the risks they have assumed. Accordingly, the profit margins should be sufficient to provide a return on capital that is acceptable to the insurer's shareholders.

Further complicating matters, in some jurisdictions there are regulatory constraints on the pricing of insurance products.

Actuaries are often heavily involved in the pricing process, particularly for long term life insurance products. They develop assumptions for the various cost factors, taking into account the design of the product, the insurer's past experience with similar products, the experience of other insurers, and expectations of future demographic and economic conditions. Actuaries use models to project future cash flows from the product, solving for the premium rates that will produce the desired profit margins.

However, rarely does the actuary's job end there. The calculated premium rates might be uncompetitive, at least for some potential policyholders, or outside of the constraints set by regulation. In such cases, the actuary may need to adjust the premium rates, for example, lowering them at some ages and raising them at others, or modify features of the product design. The actuary also needs to test the sensitivity of the profit margin to variations in the cost factors. If profitability is too sensitive to certain factors, the product design may need to be changed or an additional premium charged for the risk involved.

Liabilities

The nature of the insurance business, in which premiums are collected upfront and claims and other benefits are paid at a later date, sometimes much later, means that liabilities for future benefits are typically the largest item in an insurer's balance sheet. These liabilities are sometimes called technical provisions.[4] Most technical provisions are linked to the amounts insured under policies, although some are simply accumulations of amounts deposited by policyholders with the insurer. Some technical provisions relate to outstanding liabilities for events that have already occurred, for example, if a policyholder has submitted a claim to the insurer but the insurer has not yet made payment. Other technical provisions relate to liabilities for which a triggering event has not yet occurred. One example of such a technical provision is that established for unearned premiums, for example, where a policyholder has paid an annual premium for motor vehicle insurance but part of the policy year has not yet been completed at the date the balance sheet is calculated. Another example of such a technical provision is that established for long-term, level premium life insurance policies, where the premium rate is higher than the cost of claims in the early years of the policy, but lower than the cost of claims in the later years of the policy when the policyholder is older and more likely to die during a particular year.

In general terms, technical provisions are calculated as the present value of expected future outflows for claims and related expenses, less the present value of expected future inflows from premiums in respect of the related period of insurance coverage. The calculation is simplified in the case where the triggering event of a claim has already occurred, in which case no future premiums on the policy relate to coverage that will be collected.

The primary objective when establishing technical provisions is to ensure that they adequately recognize the extent of the insurer's obligations to policyholders. If not, and the technical provisions proved to be inadequate, the insurer could eventually find itself with insufficient assets to meet its obligations and thus become insolvent. It is also desirable that the technical provisions are fairly realistic estimates of the potential obligations. This will facilitate analysis of the insurer's balance sheet and trends in its profitability.

4. In some jurisdictions, technical provisions are referred to as "reserves." However, in an accounting sense, they are truly liabilities and appear as such in the balance sheet. Reserves, on the other hand, are allocations of surplus, which are set aside on the balance sheet to help cope with adverse conditions that might arise.

The primary, if not sole, responsibility for determining the technical provisions of many insurers is held by actuaries. This is particularly true with respect to life insurers, where the laws of most jurisdictions require the involvement of an actuary. In a growing number of jurisdictions, this is also the case for nonlife insurers.

Actuaries select appropriate methods for valuing the various types of obligations. They establish assumptions for the parameters that will affect the value of the obligations. Economic, demographic, and business conditions change over time, and information becomes available about the experience of the business that an insurer has underwritten. Therefore, the assumptions used in calculating technical provisions often differ from those used in the pricing process, and may change over time. Actuaries must ensure that the policy and claims data used in the calculations is as complete and accurate as possible. They prepare models that incorporate the methods and assumptions they have selected and apply these models to the data to calculate the technical provisions. Actuaries should also test the sensitivity of technical provisions to changes in the assumptions, to ensure that the provisions will be adequate even if future experience differs somewhat from the assumptions. The results of this testing may show a need to modify the methods or assumptions. Modern international financial reporting standards actually expect the actuary to make adjustments to the liability figures when changes in assumptions appear to be warranted.

Assets

It is not enough that an insurer establishes technical provisions in a conservative manner. The insurer must also have sufficient and appropriate assets to back up these provisions, so that it can meet its obligations when they come due. Insurers act in a fiduciary capacity and, therefore, must invest in assets that are appropriate to the nature of their liabilities. Overall, the investment portfolio should have a high level of safety, in other words, the risk of significant deterioration in asset values should be small. There must be sufficient cash and liquid assets to meet potential short-term needs without having to dispose of longer-term investments during a period when market values might be depressed. The returns on invested assets should be sufficient to meet the assumptions made in the pricing process, otherwise profitability targets are unlikely to be achieved. Finally, if the financial statements are to provide a reliable picture of the insurer's results, it is essential that assets be valued appropriately.

The investment options for insurance companies are usually limited by regulation. Within the regulation, actuaries are often involved in determining the investment policy of an insurer. Combining their understanding of the characteristics of the insurance products with knowledge of investment alternatives, they are able to recommend which types of investments would be most suitable for various types of products. They can project future cash flows from the investment portfolio and assess the possible impact of changes in the investment environment on the value, liquidity, and returns on the assets. They may also be involved in the valuation of assets, for example, developing models that can be used to value complex structured products that are not regularly traded in the investment markets. Actuaries could also make representation to the supervisory authorities in those cases where the regulations appear to be too confining and impede prudent management of the company's portfolio.

Actuaries may participate in the selection of investment managers who will be responsible for investing some or all of the insurer's assets. They can help to establish appropriate targets for performance of the investment managers and evaluate actual performance with reference to those targets. Some actuaries work in the investment operations of insurers, selecting investments and managing the mix of investments in the portfolio.

Asset and liability management

Recognizing the importance of having an investment portfolio that is appropriate to the nature of their obligations, a growing number of insurers have taken steps to actively manage the relationship between assets and liabilities on an ongoing basis. The main objective of asset and liability management (ALM) is to reduce the risk to an insurer that exists if assets and liabilities are mismatched, for example, if a change in market conditions might cause an increase in the value of liabilities while also causing a decrease in the value of assets. On a more positive note, ALM can help an insurer to invest its assets more effectively and generate higher profits.

Most insurers that practice ALM have established committees to oversee this activity. Actuaries participate in the ALM committee together with investment managers, product line managers, and financial officers.

Actuaries are often responsible for modeling the asset and liability cash flows, and assessing the effects of various risk factors on the results. They develop techniques and measurement tools that can

be used in the ALM process to reduce the effects of these risks. For example, a basic approach to ALM involves measuring the average duration of expected liability cash flows and investing in a portfolio of assets that has the same average duration.

Experience analysis

When discussing the previous elements of the actuarial control cycle, the need for an actuary to make assumptions about factors that will affect the future profitability of an insurer has been mentioned several times. In setting the assumptions, it is important to have both information about past experience with respect to each of the factors and knowledge of changes in the environment that might result in future experience being different than that of the past. Analysis of past experience provides information about what has happened, including trends that might continue into the future.

Experience analysis is useful not only in setting assumptions but also in assessing how closely actual experience has corresponded with previous assumptions. Such assessments are essential to the identification of sources of profits and losses of an insurer. They enable an actuary to revise the assumptions used in calculating technical provisions to reflect changing conditions, helping to ensure that the provisions will be adequate. The information can also used to manage the business more effectively, for example, by revising underwriting criteria to improve the quality of business, targeting marketing efforts to more profitable products and consumers, and adjusting premium rates to achieve profit objectives.

Actuaries are often responsible for conducting experience analyses. They develop the methods of analysis, identify and prepare the necessary data, and perform the analyses. They interpret the results, communicate this information to appropriate members of management, and propose actions that might be taken in response to the information.

Profitability

It is essential that insurers have a clear understanding of the sources of their profits or losses. This information can be used to help identify and deal with problems as they arise. It also aids in the identification of business opportunities, for example, products that have been more profitable than expected and might be more actively promoted. Some products have pricing elements that can be adjusted, for example,

premium rates, expense charges, or interest crediting rates. Profitability analysis, along with consideration of likely future conditions and the competitive environment, enables an insurer to make appropriate adjustments to these elements. Some products, referred to as participating or with-profits policies, involve the payment of premiums that are higher than they might need to be, on the understanding that the profits will be shared with policyholders through dividends or bonuses. In order to arrive at an equitable basis for sharing profits with such policyholders, and to help decide what portion of the profits to distribute to shareholders, understanding of sources of profitability and trends in profitability is essential.

Actuaries are involved in the analysis of profitability in several ways. They can determine the sources of profits or losses. In some cases, actuaries calculate the present value of anticipated future profits of the insurer, referred to as embedded value. Actuaries develop dividend and bonus scales for participating or with-profits business, and present their recommendations to the board of directors for approval.

On a broader scale, actuaries are often involved in developing and implementing business strategies designed to increase the profitability of an insurer. For example, they participate in identifying other insurers that might be acquired or with which an insurer might merge. They assist in determining the value of acquisition candidates. If a line of business is unprofitable, actuaries can help to assess whether the business should be run off or sold to another insurer. In such transactions, as well as situations when an insurer is changing its form of organization from mutual to shareholder-owned or vice versa, actuaries are often required to assess the effects of the transaction on policyholders and provide assurance that no class of policyholders will be disadvantaged because of the transaction.

Solvency

Insurers must remain solvent if they are to meet their obligations to policyholders, not to mention generating a positive return on the investment of their owners. Most, if not all, jurisdictions impose requirements regarding the minimum amount of capital that must be maintained by an insurer to help ensure its solvency.

In many jurisdictions, capital adequacy requirements are proportional to the risk inherent in an insurer's business. For example, the requirements might be calculated by applying a set of factors to the premiums, amounts of insurance, technical provisions, and assets of the insurer and totaling the results. In some cases, the calcula-

tion of required capital is more complex, involving the application of stochastic models of an insurer's business. Also, some jurisdictions require insurers to perform stress tests, which involve projecting the effects of adverse scenarios on the future solvency of the insurer.

Insurers must maintain at least enough capital to meet regulatory requirements, or else face the risk of being forced to cease doing business. However, if an insurer has too much capital in relation to the size and risk of its business, it will be very difficult for the insurer to generate a sufficient return on capital to satisfy its shareholders. Therefore, insurers seek to avoid holding more capital than they need to cover the risk inherent in existing business, referred to as economic capital, and to support expected future growth in their business.

Actuaries are often involved in the assessment of solvency and management of capital. They can calculate the minimum capital required for regulatory purposes, both currently and based on projections of future growth in business. Actuaries use models to perform the stress tests required by regulators and to determine economic capital. They also participate in the formulation of strategies to make effective use of an insurer's capital and to raise additional capital, if necessary.

Ensuring the quality of actuarial work

The work of actuaries can affect the financial well-being of many people, such as policyholders of insurers. Therefore, it is essential that mechanisms exist to ensure that the work done by actuaries is of high quality. Such mechanisms can include a requirement that certain qualifications be met to practice as an actuary, professional standards of practice that must be followed, and a disciplinary process to deal with those who do not practice in accordance with requirements.

In jurisdictions where the actuarial profession is well-established, these mechanisms have often been established by a professional association. However, in some jurisdictions, some or all of these elements are missing. In such cases, actuaries may be members of professional associations that are based in other jurisdictions and subject to the requirements of those associations. Sometimes, insurance regulations include provisions designed to ensure the quality of actuarial work. Nevertheless, there are still places where a person can perform actuarial work without any oversight.

The International Actuarial Association (IAA), founded in 1895, is a grouping of local actuarial associations.[5] It exists to encourage the growth of a global profession, whose members will be recognized as technically competent and professionally reliable.

Qualification

Some actuarial associations establish qualification standards that must be met by individuals who wish to become members. The qualification standards often cover areas such as education, professional knowledge, experience, and professionalism.

Actuaries require a high level of knowledge of mathematics and statistics. Most actuaries attain such knowledge through attendance at university. Some universities offer degrees in actuarial science, although many actuaries have studied at universities that do not offer such degrees, instead obtaining degrees in mathematics or related subjects.

The approach to actuarial education varies among jurisdictions. Some place more emphasis on university studies, while others require more self study, with the results tested through examinations developed by the professional association or, in some cases, a supervisory authority. The IAA has set out a syllabus of topics in which, at a minimum, competence must be demonstrated by individuals who seek qualification as actuaries. Only if a local actuarial association imposes requirements that cover at least the following topics[6] is it eligible for full membership of the IAA:

- financial mathematics
- probability and mathematical statistics
- economics
- accounting
- modeling
- statistical methods
- actuarial mathematics
- investment and asset analysis
- actuarial risk management
- professionalism.

5. For more information about the IAA, see its website at www.actuaries.org. The website also provides links to many local actuarial associations.
6. This list shows the main topic areas of the syllabus; see the IAA website for more details.

In addition to meeting educational requirements and successfully completing professional examinations, many actuarial associations require a minimum period of practical experience, under the guidance of an experienced actuary, before an individual can attain full professional qualification. Some associations require participation in formal training on ethics and professionalism, and may require the recommendations of one or more members before an individual's application for membership will be accepted.

Increasingly, actuarial associations require members to undertake continuing professional development as a condition of maintaining their membership. Such requirements are designed to ensure that actuaries are aware of evolving best practices, changes in regulatory requirements, and relevant business developments.

In many jurisdictions, full membership in a recognized actuarial association is required to perform certain official tasks, such as determining the technical provisions of an insurer. In some jurisdictions, full membership is a necessary but not a sufficient condition to perform these tasks, with additional specialized qualification requirements being imposed by either the professional association or a regulator.

Professional standards

Professional standards can play an important role in ensuring the quality of actuarial work. They can guide the work of the actuary, assist users of this work to understand what has (or should have) been done, promote consistency in the approaches taken by different actuaries, and provide a basis for taking disciplinary action against actuaries who do not work with them accepted norms.

Professional standards can cover many aspects of actuarial work. Some standards deal with technical issues, such as appropriate actuarial methods, the selection of assumptions, and controls that should be exercised over the quality of data. Others deal with communication issues, such as the elements that must be covered in a formal actuarial report. Most actuarial associations have established a code of conduct that their members must observe, to ensure that their behavior is professional and ethical. In some cases, professional standards deal with quality control mechanisms, such as requiring that actuarial reports be reviewed by another qualified actuary.

There is not yet a full set of internationally-accepted actuarial standards. In some jurisdictions, comprehensive written professional standards have long been in place. In others, only partial standards are in place, for example, a code of conduct. The IAA has developed standards in recent years, most of which are intended to provide nonbinding guidance to actuaries who are valuing insurance contract liabilities for the purpose of financial reporting under International Financial Reporting Standards (IFRS).[7]

Many actuarial associations have established disciplinary processes. Complaints against members are investigated and, where warranted, disciplinary action is taken. Such action could range from private counseling of the member, to public reprimand, to suspension of or expulsion from membership.

Regulation and supervision

Insurance supervisory authorities are very interested in ensuring the quality of actuarial work. High quality actuarial work contributes to the sound operation of insurers and the reliability of their financial statements, both of which are of considerable importance to supervisory authorities.

As mentioned above, in some jurisdictions there may be no actuarial association or its qualification requirements and professional standards may be weak or incomplete. In such jurisdictions, laws and regulations sometimes assigned responsibilities to the supervisory authority that might otherwise be performed by a professional association. For example, they might be charged with assessing the qualifications of those who wish to work as actuaries and deal with disciplinary matters.

Even in jurisdictions where the actuarial profession is well established and the professional standards are strong, the responsibility for ensuring the quality of actuarial work is often shared between the actuarial association and the insurance supervisory authority. For example, regulations might prescribe the methods and key assumptions that can be used by an actuary in calculating technical provisions. Alternatively, professional standards might provide guidance on actuarial methods and the selection of assumptions, with regulations requiring that the methods and assumptions chosen by the actuary be acceptable to the supervisory authority.

7. See the IAA website for the international standards, as well as links to the standards established by some of its member associations.

In some jurisdictions, actuaries have formal roles within the supervisory process.[8] Such roles may include the following:

- reporting to the insurer's board of directors on the financial condition of the insurer
- reporting to the supervisory authority on the financial condition of the insurer
- reporting to the supervisory authority on the profitability of new life insurance products
- justifying to the supervisory authority the need for increases in motor vehicle insurance premium rates
- attesting to the fairness of policyholder dividend scales before they are approved by an insurer's board of directors
- attesting to the reasonableness of the allocation of a portion of the profits on participating or with-profits business to shareholders
- conducting stress testing of the adequacy of an insurer's capital and reporting the results to the board of directors and, perhaps, the supervisory authority
- reporting to the supervisory authority any matters that the actuary believes may seriously threaten the financial condition of the insurer, sometimes referred to as "whistleblowing."

It is important that supervisory authorities have access to actuarial expertise. Actuaries can help to interpret the information provided by insurers' actuaries, and to assess the quality of that work. Their expertise is also essential in formulating regulatory requirements, both those applicable to the work of actuaries and those governing the operation of insurers. For example, actuaries are often involved in designing risk based capital adequacy requirements and establishing investment limitations.

Often, for a variety of reasons, it is difficult for supervisory authorities to hire actuaries as part of their staff. Sometimes, there are simply no actuaries residing in the jurisdiction. In other cases, the few actuaries that might be available are in high demand, making their salaries unaffordable, particularly for a smaller supervisory authority. Faced with such challenges, many supervisory authorities rely on consulting actuaries to provide the expertise they need. In fact, even those that have actuaries on staff sometimes retain consulting actuaries provide assistance in the areas that require highly specialized expertise.

8. See the International Association of Insurance Supervisors (IAIS) Guidance Paper on the Use of Actuaries as Part of a Supervisory Model, available at www.iaisweb.org.

Conclusion

Actuaries are professionals who specialize in evaluating the financial implications of contingent events. Their evaluations often involve the use of models that reflect both the stochastic nature of insurance and the time value of money.

Since the insurance business exists to protect against the financial consequences of adverse events, it is not surprising that actuaries are involved in many aspects of the operations of insurers. The actuarial control cycle highlights the areas in which actuaries can contribute to the success of an insurer.

As professionals whose work can affect the financial well-being of many people, actuaries should be subject to qualification requirements and professional standards of practice. Their work should be subject to oversight, to ensure that it is done in a professional manner. It is of interest to supervisory authorities, which can also benefit from the use of actuaries.