7 – Actuarial Operations

**1 – The Actuarial Function**

**Objective**: Summarize the actuarial function in insurer operations and the actuarial services required by insurers.

Actuaries are professionals who evaluate the financial consequences of future events. As such, they play a critical role in the fields of insurance and risk management.

The actuarial function is responsible for ensuring that the insurer operates effectively and conducts its operations on a financially sound basis. The two most prominent actuarial functions for an insurer involve ratemaking and estimation of unpaid liabilities and adequacy of loss reserves. Actuaries are also instrumental in developing an insurer’s predictive models, and they perform other important functions for insurers, including analyzing reinsurance structure and participating in corporate planning and budgeting.

**What is an Actuary?**

There are many definitions of what an actuary is. First actuaries are professionals; they have a formal educational process, a set of standards for performance, and a code of conduct. Focusing on the financial effects of risk, actuaries are found throughout the business world, often employed by either insurance companies or firms supplying services to insurers. **Actuaries often rely heavily on mathematical models and statistical techniques, but their examination process also covers insurance operations, accounting, insurance law and financial analysis.**

**Actuarial Functions**

One of the major functions of actuaries is to ***direct insurer ratemaking operations***. Actuaries also develop factors that are applied to loss costs in order to reflect individual insurer experience and expenses. The ratemaking process involves estimation of trends that will affect claims costs during the future effective period of the rates. Thus, the actuary must consider economic and regulatory factors that will affect the potential cost of coverage.

Another major function of an actuary involves the estimation of an insurer’s unpaid liabilities and adequacy of its loss reserves. Insurers are required by both accounting standards and law to set aside funds for the future payment on claims for which they are liable. Actuaries use various methods to estimate the amount of these liabilities. In the US, insurers are required to submit, with the statutory annual statement, a statement of opinion by a qualified actuary as to whether the carried reserves make a reasonable provision for this liability. The actuary providing this statement must have been approved by the insurer’s board of directors and is named individually in the statement.

Actuaries are also instrumental in developing insurer’s predictive models using data mining tools – the process of extracting hidden patters from date that is used in a wide range of applications for research and fraud detection. Predictive modeling is increasingly being applied in areas such as ratemaking, underwriting, claims analytics, customer segmentation, and target marketing, which can lead to increased profits for an insurer.

Because of their quantitative background and familiarity in dealing with uncertain events, actuaries often perform other tasks, primarily related to assessment of insurer risks, including these:

* Analyzing reinsurance needs to determine the level and concentration of risk the insurer can retain versus the cost of reinsurance
* Estimating future cash flows so that assets will be available when claims are to be paid
* Assessing corporate risk by testing the adequacy of surplus under potential adverse conditions (catastrophe, sudden change in asset values, soft pricing and inflation)
* Providing financial and statistical information to regulators and applicable statistical agents
* Participation in corporate planning and budgeting

**Actuarial Services**

Many large insurers employ a number of actuaries. Although small insurers may have a few actuaries on staff, most tend to rely on actuarial consultants.

**Insurers that employ staff actuaries may also retain actuarial consultants. Outside actuaries can supplement staff knowledge with specialized expertise, provide independent opinion when needed, and ease workload peaks. Regulatory authorities and reinsurers sometimes require insurers to provide consulting actuary’s opinion verifying the accuracy and reasonableness of the staff actuaries’ work**.

**Insurers with limited data for ratemaking rely on rates or loss costs prepared by actuaries at advisory organizations such as ISO, or AAISI, or the NCCI. The actuaries at these organizations collect premium and loss data from any insurers to use in calculating expected loss costs for various types of insurance. Advisory organizations also maintain contact with regulatory authorities to facilitate approval of rate filings**. Advisory organizations also provide some services that are not actuarial, such as drafting insurance policies.

**2 – Insurer Ratemaking Goals**

**Objective**: Describe the insurer goals of ratemaking and the ideal characteristics of rates

Even with years of statistics and insurance records as a resource, it is impossible for insurers to predict the future with complete certainty. Therefore, they must accept some risk when it comes to setting rates that they hope will cover the future forecasting the fortuitous losses their policyholders will suffer, and estimating associated expenses. Throughout the ratemaking process, insurers strive to be profitable while also meting all insurance policy obligations. An ideal insurance rate has a number of different characteristics, including some that are contradictory.

**Ratemaking Goals**

**From the insurer’s perspective, the primary goal of ratemaking is to develop a rate structure that enables the insurer to compete effectively while earning a reasonable profit on its operations. To accomplish this, the rates must result in premiums that adequately cover all losses and expenses and that leave a reasonable amount for profit and contingencies**.

This ratemaking goal complements the underwriting goal of developing and maintaining a profitable book of business. To be profitable, the insurer must have adequate rates, but to maintain its customer base, the insurer’s rates must be competitive. These goals can create conflict, the rate chosen by the insurer is often a compromise between maximizing profit and maintaining (or expanding) market share.

**To be approved, rates must comply with applicable regulations, which generally mandate rates that are adequate, not excessive, and not unfairly discriminatory**.

**Ideal Characteristics of Rates**

**Ideally, rates should have 5 characteristics:**

* **Be stable**
* **Be responsive**
* **Provide for contingencies**
* **Promote risk control**
* **Reflect differences in risk exposure**

Rates do not always have all of these characteristics. Also, some characteristics conflict with others, and compromises are often necessary. Example, maintain rate stability could conflict with being responsive, which suggest that rates should change promptly in response to external factors that affect losses.

**Stable**

Stable rates are highly desirable because it is expensive to change rates, involving a fair amount of time and expense to calculate rate indications, obtain needed approval, and the implement the new rates. Generally, rates are changed no more than once a year. Sudden large rate changes can cause dissatisfaction among customers and sometimes lead to regulatory or legislative actions.

**Responsive**

Rates should include the best possible estimates of losses and expenses that will arise from the coverage. The most recent claims experience ought to predict future experience better than older experience.

**Provide for Contingencies**

Future events cannot be predicted with absolute certainty. **The rates charged for coverage should provide for contingencies, such as unexpected variations in losses and expenses. This provision also provides greater security that the insurer will be able to meet its obligations to potential claimants.**

**Promote Risk Control**

Ratemaking helps promote risk control by providing lower rates for policyholders who exercise sound risk control. Such as policyholders who install burglar alarm systems receive a reduction in crime insurance. And policyholders who engage in activities that tend to result in more losses, such as using their own cars for business, generally pay higher rates.

**Reflect Differences in Risk Exposure**

Ideal rates reflect the amount of risk the insured is exposed to. The owner of a wood frame home would ideally pay more for fire insurance than someone who lives in a concrete building. By differentiating the rates in this way, the insurer increases its chances of keeping the owner of the concrete home as a customer and encourages the owner of the wood frame home to take protective measures.

Treating both insureds equally would probably cause the owner of the concrete home to look elsewhere for more reasonably priced coverage. Therefore, it is beneficial for insurers to use all data available to them to rate each exposure individually.

**3 – Rate Components and Ratemaking Terms**

**Objective**: Describe the components of an insurance rate and common ratemaking terms.

Insurance premiums can sometimes seem like amorphous, arbitrary constructions. They are based on definitive rates that consider various factors, however having a thorough understanding of these factors will help insurance professionals explain the financial impacts of insurance to insureds.

Knowledge of the specific components and terms used in ratemaking provides a foundation to understanding the process. Understanding how investment income can affect an insurer’s ratemaking can create further transparency in the process.

**Rate Components**

**An insurance rate consists of 3 components:**

* **An amount needed to pay future claims and loss adjustment expenses (prospective loss costs)**
* **An amount needed to pay future expenses, such as acquisition expenses, overhead, and premium taxes (expense provision)**
* **An amount of profit and contingencies (profit and contingencies factor)**

**The first component of an insurance rate is related to the prospective loss costs developed by advisory organizations or by insurers with large pools of loss data. The second and third components are related to an expense multiplier. Once the insurance rate is calculated, it is multiplied by the appropriate number of exposure units to produce a premium**.

**Ratemaking Terms**

These are common terms used in the ratemaking process:

* **Exposure bases (sometimes just exposure)** is a variable that approximates the loss potential of a type of insurance. Property – value being insured; Product liability – sales)
* **Earned exposure unit** – unit for which the insurer has provided full period of coverage (years)
* **Pure premium** – the amount included in the rate per exposure unit required to pay losses (sometimes called the loss cost) the average amount of money the insurer must charge per exposure unit in order to be able to cover the total anticipated losses for that line of business.
* **Expense provision** – the amount added to the pure premium required **to pay expenses, such as acquisition expenses, general expense, premium taxes,** licenses and fees paid to government, regulatory, and advisory organizations. (includes loss adjustment expenses, excludes investment expenses)
* **Loss adjustment expenses (LAE) – expenses associated with adjusting** claims. Often split into either allocated loss adjustment expenses (ALAE) or unallocated loss adjustment expenses (ULAE). Legal fees to defend a claim, cost of insurer’s in-house claims adjusters. (cost to investigate, defend, and settle claims)
* **Insurers add a loading, or additional cost, to profit and contingencies**. If excessive losses or expenses are not incurred, the funds generated by the loading produce additional profit for the insurer.

**Investment Income**

A property casualty insurer performs two distinct operations: insurance operations and investment operations.

*The insurance operations write policies, collect premiums, and pay losses, resulting in underwriting profit. The investment operations use these funds to buy or sell bonds, stock and other investments to earn a profit, which is called investment income*.

Historically, property casualty insurers did not directly consider their investment returns when calculating insurance rates. They may, however, have informally considered investment returns when determining allowances for profit and contingencies.

Today insurers often consider investment results explicitly in rate calculations. Some states even require this practice. Sophisticated models are available that can be used to include investment returns in the insurance rate.

**The investment return earned by an insurer depends largely on the types of insurance written, the loss reserves, and associated unearned premium reserves. Property losses are paid relatively quickly, while liability losses often are not paid until years after a loss.**

**An insurer’s loss reserves for liability insurance are usually much greater than its loss reserves for an equivalent amount of property insurance. Because the assets that support the loss reserves are invested to produce income for the insurer, investment returns have a much larger effect on liability insurance rates than property insurance rates**.

**4 – Factors That Affect Ratemaking**

**Objective:** Explain how the following factors can affect ratemaking: Estimation of losses; Delays in data collection and use; Change in the cost of claims; Insurer’s projected expenses; Target level of profit and contingencies

It is never easy to predict the future, to which any weather forecaster can attest, but that is exactly what insurers are expected to do when setting rates for insurance coverage. Several factors can have varying degrees of effect on a coverage’s rate, but a good understanding can help insurance professionals keep unexpected rate increases to a minimum for their clients.

These areas of ratemaking can be affected by inherent uncertainty of trying to predict events and estimate future costs.

**Estimation of losses**

Properly estimating the amount of losses for future claims is the key to developing adequate insurance rates. Past loss experience is generally used as a starting point to estimate future losses. Ratemaking is based on estimating losses from past coverage periods and adjusting those losses for future conditions. Example, adjustments for anticipated future inflation for changes in benefits mandated by legislation could be make to past loss experience.

**Past loss experience may not be completely known because not all covered losses are paid immediately. At any point in time, many claims have been incurred but not yet paid. The difference between the estimated amount that is set aside to ultimately pay for claims and the actual loss amount paid to date is the loss reserves**. Insurers face the challenge of estimating ultimate losses for past experience as accurately as possible because of the difficulty of estimating future payments.

**Insurance rate are based partly on incurred losses. Incurred losses include both paid losses and outstanding loss reserves. Loss reserves are estimates of future payments for covered claims that have already occurred, whether the claims are reported or not. Insurers are legally required to set aside funds for these future payments; these are shown as liabilities on their balance sheets. Because loss reserves are estimates of future events, they are somewhat imprecise. Rates are based partly on such estimates. Therefore, if loss reserves estimates are too low, rates will probably be too low. If loss reserves are too high, rates will probably be too high as well**.

To illustrate, assume that rates for auto liability insurance are calculated based on losses that occurred in the most recent 3 year period. The insurer’s past experience indicates that 25% of losses are paid in the year the accident occurs, 50% are paid in the 2nd year, and 25% are paid in the 3rd year.

Hypothetical Auto Liability Loss Experience at Year End 3:

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1 | 2 | 3 |
| Year | Paid Losses | Loss Reserves | Incurred Losses |
| 1 | 10,000,000 | 0 | 10,000,000 |
| 2 | 7,500,000 | 2,500,000 | 10,000,000 |
| 3 | 2,500,000 | 7,500,000 | 10,000,000 |
| Total | $20,000,000 | 10,000,000 | 30,000,000 |

The exhibit shows the losses for each year in the 3 year period, with year 1 being the earliest and Year 3, the most recent.

* The paid losses in Column (1) are the amounts paid from January 1 up to and including December 21 of Year 3. The insurer has already paid this money to claimants
* The loss reserves shown in Column (2) are the insurer’s best estimates, as of December 31 of Year 3, of the amounts it will pay in the future for losses that occurred during each one-year period. Because all losses that occur in Year 1 have been paid, no loss reserve exists for Year 1.
* Column (3), which is incurred losses for a given period, is the sum of columns (1) and (2)

**In the insurer in this exhibit insured 100,000 cars each year during the 3 year period, it provided 300,000 car years of protection. A car year represents the loss exposure of one care insured for one year. If the 300,000 car years is dividing into the $30M of incurred losses, the insurer needs a pure premium – the amount need to pay losses of $100 per car every year ($30,000,000 divided by 30,000 = $100) to pay its losses during this past 3 year period.** This example includes not only paid losses but also loss reserves.

**If the pure premium indicated by this experience period were used to develop rates for a future year, any inadequacy in past loss reserves would also make future rates inadequate, assuming conditions remaining the same. Using the preceding example, assume that the loss reserves were underestimated by 15%; that is, the company had only $8,500,000 in loss reserves at the end of year 3 instead of $10,000,000. The total incurred losses for the years would then be $28,500,000 and the calculated pure premium would be only $95 per car per year. Rates based on underestimated losses could lead to underwriting losses and possible even insolvency.**

In Theory, an insurer could avoid this problem by waiting for all claims to be paid before using loss experience to calculate rates. When all claims incurred during a given period have been paid, there is no need for loss reserves. In practice, however, waiting would create problems. If the rate filing were delayed for several years to permit all claims to be settled, then factor such as inflation, changes in traffic conditions, and so forth would have a greater chance of changing the loss exposure. The effect of these factors might be greater than the effects of errors in estimating loss reserves.

**Delays in Data Collection and Use**

Responsiveness is a desirable ratemaking characteristic. Because conditions are constantly changing, any delay between when data is collected and when it is used tends to reduce rate accuracy. Unfortunately, delays between when losses are incurred and when they are reflected in rates charged to customers are unavoidable and can span several years. During this period, factors – economic and otherwise – can increase or decrease the rates the insurer should charge if the premium is to reflect the expected losses. **The delay in reflecting loss experience in rates stems from several sources, including these:**

* **Delays by insureds in reporting losses to insurers**
* **Time required to analyze data and prepare a rate filing**
* **Delays in obtaining state approval of filed rates**
* **Time required to implement new rates**
* **Time period during which rates are in effect, usually a full year**

When a rate is in effect for a full year, the last policy issued under that rate could be issued 365 days (one year) after the effective date of the rate filing, and the policy’s coverage under that rate continues until policy expiration, yet another year later. Example

Policy Year Time Frame:

1/1/x1 12/31/x1 12/313/x2

Beginning of policy Last policy issue Policies issued expire

A typical schedule for developing, approving, and implementing new rates for auto insurance might have a 6 year cycle, assuming the insurer is basing its new rates on its loss experience for a prior 3 year period, called the experience period. Data from the experience is collected and analyzed in the ratemaking process. Chronology of Rate Filing

1/1, Year 1…………… Start of experience period, first loss incurred

12/31, Year 1

12/31, Year 2

12/31, Year 3 …………End of experience period

3/31, year 4……………Start of data collection and analysis

7/1, year 4……………… Rates filed with regulators

9/1, year 4……………… Approval of rates received

1/1 Year 5………………. New rates initially used

12/31, Year 5…………… Rates no longer used

12/31, Year 6…………… Last loss incurred under this rate filing

If the first experience period begins on January 1 of year 1, data will be collected for a 3 year period beginning on that date and ending on December 31 of year 3. For most insurers, *the analysis phase of the ratemaking process begins 3 months after the end of the experience period.*

The exhibit assumes that the new rates will become effective on January 1 of Year 5, one year after the end of the experience period. They will remain effective until December 31 of year 5, two years after the end of the experience period. However, the policies issued on December 31 of year 5 will remain in force until December 31 of year 6. Consequently, the last claim under these rates will be incurred three years after the end of the experience period and six years after the beginning of the experience period, when the first losses on which the rate calculation was based occurred.

**Change in Cost of Claims**

**Both loss severity and loss frequency affect an insurer’s loss experience during any given period. Economic inflation or deflation during the inevitable delay also affect the average cost of a loss (severity). Finally, legislative or regulatory changes, such as modification in rules governing claims settlement, can affect the number of losses (frequency). Rates calculated without regard to these factors could prove to be grossly inadequate or grossly excessive**.

These factors are difficult to quantify, but they clearly affect losses. Some factors that affect the size and frequency of losses cannot be identified or measured directly, but their aggregate effect on losses can be determined with reasonable accuracy by trending. The effects of historical changes can be employed to adjust the experience used in the ratemaking analysis. In addition, the rates must include a provision for changes that may arise during the period rates will be in effect.

**Insurer’s Projected Expenses**

Insurance rates are also based on the insurer’s projected expenses. Like losses, expenses can change over time, and projected changes must be considered in the ratemaking process. Rather than past expenses, it is sometimes more relevant to use judgment or budgeting expenses, especially when conditions change dramatically. Example, a new agent commission plan was introduced, the past commission expense would not be a good estimate of the cost for new policies.

Ratemakers are also challenged to allocate general administrative expenses properly among different types of insurance. Changes in the allocation of these expenses may need to be reflected in the rates.

**Target Level of Profit and Contingencies**

The insurer must decide what provision for profit and contingencies should be included in the rate. Consideration is given to the overall desired rate of return, including likely returns from investment income versus underwriting profit, respectively. An insurer may initially accept a lower profit (and thus charge lower rates) for a new insurance product in order to build a customer base.

**5 – Ratemaking Methods**

**Objective:** Compare the following ratemaking methods: Pure Premium; Loss Ratio; Judgment

|  |  |  |
| --- | --- | --- |
| **Method** | **Data Required** | **Uses** |
| Pure Premium Method | Incurred losses  Earned exposure units  Expense provision  Profit and Contingencies factor | To develop rates from past experience (cannot be used without past experience) |
| Loss Ratio Method | Actual loss ratio calculated from   * Incurred losses * Earned premium   Expected loss ratio calculated as:  100% - provision for expenses,  Profit, and contingencies | To modify existing rates (cannot be used without existing rates; cannot be used to determine rates for a new type of insurance |
| Judgment method | Rates based on experience and judgment | To develop rates when data are limited (requires skilled judgment) |

**Pure Premium Ratemaking Method**

**The pure premium method uses loss per exposure based on past experience as the basis for the rate. The method relies on past experience but is independent of any current rates.**

The pure premium method has 4 steps**, the first of which is to calculate the pure premium. This is done by dividing the dollar amount of incurred losses by the number of earned exposure units:**

Incurred losses = $4 million

Earned car-years = 100,000

Pure Premium = Incurred losses divided by earned car-years $4M divided by 100,000 = $40

**The second step is to estimate the expenses per exposure unit based on the insurer’s past expenses (except investment expenses and possible loss adjustment expenses**. Whatever loss adjustment expenses are included in the pure premium are excluded from the expenses. Investment expenses are not directly reflected in rate calculations. if expenses are $1.7 million, then expenses per exposure unit are as shown:

$1,700,000 divided by 100,000 = $17

**Determining the profit and contingencies factor, this example uses a factor of 5%, but it can vary. A provision for net investment income is generally included within the profit provision**.

Rate per exposure unit = Pure premium + Expenses divided by 1 – profit and contingency factor

$40 + $17 divided by 1 – 0.05 (1 – 0.05 = .95)

**The final step is to add the pure premium and the expense provision and divide by one minus the profit and contingencies factor**. So the calculation will be $57 divided by .95 = $60

The rate per exposure unit of $60 is equal to the pure premium of $40 (the amount required to pay losses) plus an additional $17 (the amount required to pay expenses) and $3 (for profit and contingencies) 57 + 3

Some insurers separate their expenses into two components: fixed expenses and variable expenses. Fixed expenses are stated as dollar amounts per exposure unit. Variable expenses are stated as percentages of the rate.

For example, the insurer in the preceding example might decide that its cost for issuing a policy and collecting the premium is $2.50 per car year, regardless of the premium size, rating class, or rating territory. Its other underwriting expenses such as commissions and premium tax, vary by premium size. The variable expenses equal 12% of the final premium, so this would be the rate per exposure unit:

$40 + $2.50 divided by 1 – 0.12 - 0.05 which would be

$42.50 divided by 0.83 = $51 (rounded)

The new $51 rate exposure unit is equal to the sum of pure premium of $40 (the amount required to pay the loses or loss costs), fixed expenses of $2.50, variable expenses of $6 (rounded), and profit and contingencies of $2.50 (rounded) $51 – 42.50 (pure premium and fixed expenses) leaves $8.50 which are the variable expenses of 0.12 ($6.00) and the profit and contingencies of 5% ($2.50)

**Loss Ratio Ratemaking Method**

**The loss ratio method, in its simplest form, uses two loss ratios - the actual loss ratio, and the expected loss ratio of the insurer during the selected experience period**:

1. Actual loss ratio = Incurred losses divided by earned premiums

2. Expected loss ratio = 100% - Expense provision

Because this method modifies a current insurance rate, profit and contingencies are included in the expense provision. The expected loss ratio plus the provision for expenses, profit and contingencies always add up to 100 %. The basis loss ratio ratemaking option looks like this:

Rate change = Actual loss ratio – Expected loss ratio divided by expected loss ratio

If the rate change percentage is negative, it indicates a rate reduction. If positive, it indicates a rate increase. For example, if the actual loss ratio equals 54% and the expected loss ratio equals 60%, then the rate change is a decrease of 10% (0.54 – 0.60 = - 0.06) -0.06 divided by 0.60 = - 0.10 (-10%)

Here the insurer’s actual loss ratio was better than expected. Based only on this information, the insurer could likely lower its rates and still make the desired profit on business. Lower rate could also attract additional business further producing profits.

**The loss ratio ratemaking method cannot be used to calculate rates for new types of insurance, because there is no actual loss ratio for the calculation and no existing rate to adjust. Either the pure premium method or the judgment method must be used for a new type of insurance.**

**Judgment Ratemaking Method**

**A judgment ratemaking method is the oldest ratemaking method. Although its application is no longer widespread as it once was, it is still used for some types of insurance such as ocean marine insurance, some inland marine classes, aviation insurance, and terrorism coverage**. Although this method might use limited or no loss experience data, an experienced underwriter or actuary generally has a sense of what rates have produced desired results in the past.

**6 – Ratemaking Process Overview**

**Objective**: Describe the steps in the ratemaking process

Understanding what is involved in the ratemaking process can help insurance professionals contribute to each step in the process.

The create and revise insurance rates, either an insurer’s staff or an advisory organization working on behalf of the insurer follows these steps:

An insurer follows a similar process when reviewing loss costs. For companies that rely on loss cost filing made by advisory organization, the ratemaking process involves calculating and filing an appropriate loss cost multiplier (a factor that provides for differences in expected loss, individual company expenses, underwriting profit and contingencies, when multiplied with a loss cost, it produces a rate.)

**Collect Data**

**Before collecting ratemaking data, the insurer must determine the kinds of data needed. Generally, the data falls into these categories:**

* **Losses, both paid and incurred (including loss adjustment expenses to be included in the pure premium)**
* **Earned premium and/or exposure information**
* **Expenses, including factors for profit and contingencies**

If rates are to vary by rating class and/or territory, data must be identified for each class and territory**. If an insurer is establishing a new class of business, it would first identify experience for this class separately.**

Ideally, the incurred losses, earned premiums, and earned exposure units should b based on the same group of policies. This isn’t always practical, so approximations are used.

Depending on the circumstances, different aggregations of data may be used. For example, loss payments for a single claim, such as liability or workers compensation claim, could be made over several successive calendar years, so the calendar year method would be unsuitable because the delay in loss payment can be long, and the loss reserves can be large compared to earned premiums. For these types of insurance either the policy-year method (all policies issued in a given 12 month period and links all losses, premiums and exposure units to the policy to which they are related)or accident year method (ratemaking statistics that uses incurred losses for an accident year, which consists of all losses arising from accidents that occur during the year, and that estimates earned premiums by formulas from accounting records.)

For fire, inland marine, and auto physical damage insurance, losses are paid relatively quickly, and loss reserves tend to be small compared to earned premiums, so the calendar year method may work with these policies. However, it’s not as accurate as the other two methods.

**Adjust Data**

**After data is collected, it must be adjusted because the raw exposure, premium, and loss data reflect conditions from present and past periods, while the new rates will be used in the future**.

**Actuaries adjust premium and loss data in these ways:**

* **Adjust premiums to current rate level**
* **Adjust historic experience for future development**
* **Apply trending to losses and premium**

**Adjust Premiums to Current Rate Level**

If rates charged in the experience period were written at different rate levels, then premiums must be adjusted to the current level. The ideal way is to calculate the premium for each policy in the experience period at current rate level. This requires storing, retrieving, and using every rating factor for each policy exposure, which may make this method unfeasible. An alternative is to adjust historic premiums in total to current levels.

Assume a book of business has $100 of losses each year. In year 1, a premium of $200 is charged, but the insurer decreases rates by 20% in each of the next 2 years. So an insured that paid $1,000 premium in the first year would pay only $640 after the two rate decreases. Say the insurer had a 50% loss ratio the first year, 63% the second year and 78% the third year. It would be inappropriate to protect the coming year’s loss ratio as the average of those ratios. The 50% loss ratio in year 1 was based on premiums that would not be charged as of year 3, so it should not be used directly for ratemaking. The premium that had been charged must be adjusted to what would be charged in year 3, the most recent year.

Effect of On-Level Premium Adjustment

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Year | Developed Losses | Collected premium | = (1)/(2)  Collected loss ratio | Rate level index | On level factor | = (2)x(5)  On level premium | = (1)/(6)  On Level Loss Ratio |
| 1 | $100 | $200 | 50% | 1.00 | 0.64 | $128 | 78% |
| 2 | $100 | $160 | 63% | 0.80 | 0.80 | $128 | 78% |
| 3 | $100 | $128 | 78% | 0.64 | 1.00 | $128 | 78% |

Column 4 in the table shows the rate level relative to year 1. This rate level index reflects that rates decreased 20% from the prior year in both Year 2 and Year 3. The on-level factor (a factor that is used to adjust historical premiums to the current rate level) in column 5 adjusts rate levels for each year to the most recent period’s rate levels. It equals the rate level index for the most recent period (year 3) divided by the rate level index for each year. At the most recent year’s rate level, each year’s losses would have a 78% loss ratio.

Premiums may also have to be adjusted because of changes in the levels of coverage being purchased. For example, an automobile liability insurer finds it’s now selling much more if its $100,000 per accident limits than the $25,000 limit it had in the past. The premiums (and perhaps losses) need to be adjusted.

**Adjust Historic Experience for Future development**

When policy-year or accident year experience is used to predict future results, the experience might not be complete. There may still be open claims that require future payment, or a claim for which the insurer is liable could be reported late. The insurer must estimate the values of these future payments and add them to the payments to date to estimate the losses in each period.

The future development of the losses can be estimated using several methods. The most common is applying loss development factors to the current experience. Loss development factor is an actuarial means for adjusting losses to reflect future growth on claims due to both increases in the incurred amount for reported losses and incurred but not reported IBNR losses. With any method, the goal is to estimate the final, total cost to pay all claims within each year. These projections re used as the basis for estimating the losses that will e incurred in the proposed policy period.

**Apply Trending to Losses and Premium**

Another way to adjust losses for ratemaking is with trending -reviewing historic environmental changes and projecting changes into the future. Examples are inflation of claims costs, the increasing safety of newer cars, and changes in legal liability.

Trend data can come from various sources. Examples, Consumer Price Index, ISO, or NCCI. A trend adjustment commonly involves using historical experience to project past trends into the future.

Loss trending is usually reviewed using separate severity and frequency components. These trends can be projected into the future using exponential trending method, which assumes that data being projected will increase or decrease by a fixed percentage each year from the previous year. For example, claim frequency will increase 1.3% each year, or claim severity will increase 8.2% each year. Exponential tends have a compound effect over time. See the Claim Severity Trend Calculation:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 |
| Accident Year | Developed losses | Developed Number of Claims | = (2)/(3)  Average Claim severity | Change from prior year |
| 20x1 | $11,000,000 | 9,167 | $1,200 |  |
| 20x2 | $10,287,750 | 7,913 | $1,300 | 8.3% |
| 20x3 | $11,112,000 | 7,880 | $1,410 | 8.5% |
| 20x4 | $10,659,000 | 6,995 | $1,524 | 8.1% |
| 20x5 | $11,275,000 | 6,860 | $1,644 | 7.9% |
|  |  |  | Average | 8.2% |

The losses and claims are the estimated final values for each accident year, projected using development factors or other methods.

Losses may need to be adjusted to current conditions if significant external changes have affected loss payouts in recent years. For example, workers compensation benefits are established by statute; if legislation or a court decision changes the benefits, past losses must be adjusted to current benefit levels.

Premiums may also need to be adjusted to reflect changing conditions. If home prices rise, more homeowners insurance premiums might be collected on a house just because of its increase in value.

**Calculate Overall Indicated Rate Change**

**The purpose of adjustments, development, and trending is to bring prior experience to a level likely to match what will happen in the future policy period. Based on the adjusted experience, an indicated rate is calculated. In some cases a new rate is calculated directly. But in most cases, the indicated rate shows a change from the current rate** – a 2.7% increase, for example. Several methods, such as the loss ratio method and the pure premium method can be used to produce an indicated rate. The method used depends on the experience data available.

**Determine Territorial and Class Relatives**

**If rates vary by territory and/or class, they are reviewed after the calculation of the overall rate change. Further analysis is performed to determine territorial and/or class relatives. These relativities show which subsets of insured in a state deserve different rates than the state average rate.** Example, a territory with many congested highways, auto rates might be 8.6% higher than the statewide average.

**Territorial relativities can be determined by comparing the estimated loss ratio (or pure premium) for each geographic territory to the statewide average loss ratio (or pure premium). This comparison helps determine experience in each geographic territory**. If a territory has limited experience, its loss ratios are likely to vary widely from other territories, and differences from the overall average rate must be supported by credible experience. So if a territory has limited experience, even very good (or very poor) experience will produce only minimal difference from the average rate because it’s more likely that chance played a role in the experience.

Class relatives, which are determined similarly to territorial relativities, are used to develop rates for each rating class. Once class relatives have been determined, the insurer can prepare a rate table showing ratees for each territory and each rating class.

**Prepare and Submit Rate Filings**

Rate filings must be prepared after data has been collected and adjusted and after territorial and class relativities have been determined. Rate filings are submitted to state regulatory authorities.

Forms and requirements vary by state but generally must include these items:

* Schedule of the proposed rates
* Statement about the percentage change in the statewide average rate
* Explanation of differences between the overall statewide change in rate and the percentage change of the rates for individual territories and/or rating classes
* Data to support the proposed rate changes, including territorial and class relativities
* Expense provision data
* Target profit provision included in the rates, if applicable, and supporting calculations
* Explanatory material to help state regulators understand and evaluate the filing

In some states, rates must be approved before they are used. In other, formal approval is not required, but many insurers prefer to obtain approval before use to avoid the possibility of having to withdraw the rates if regulators decide that the rates do not meet statutory requirements. Actuaries are best qualified to answer technical questions that regulators might raise.

If an advisory organization files rates or loss costs on behalf of an insurer, it handles follow up or negotiations. Generally, companies that use an advisory organization are assumed to adopt the filings made by the organization automatically. When loss costs are filed by an advisory organization, the insurer is responsible for filing its expense provisions, which yield its final rates.

**7 – Ratemaking Factor Variances by Type of Business**

**Objective**: Evaluate how the following ratemaking factors vary by type of insurance; Experience period; Trending; Large Loss limitation; Credibility; Increased limits factors

Ratemaking is critical component of insurance, and the process is made up of many factors. Understanding how and why the use of these factors changes is essential to ensuring that the ratemaking process is completed correctly and efficiently.

The use of ratemaking factors such as experience period, trending, large loss limitations, credibility, and increased limits factors can vary widely, based on the type of insurance being evaluated. In addition, variations can result from characteristics of loss exposures, regulatory requirements, and other factors.

**Experience Period**

An experience period of one to three years is common for auto insurance and other types of liability insurance. For fire insurance, a 5 year period is used almost universally because many states require it. But the experience for each of the 5 years is not given equal weight. The most recent years are given greater weight.

The experience period used for other property causes of loss, such as wind, is even longer – frequently 20 years or more – to avoid the large rate swings that would otherwise result after a major hurricane, or tornadoes.

**Typically, three factors are considered when determining the experience period; legal requirements, if any; variability of losses over time; and credibility of the resulting ratemaking data**.

**Trending**

Trending practices also vary. For property insurance, loss claim frequency is low and generally stable, so trending may be restricted to claim severity. But since infrequent large claims can distort the average property insurance claim the average claim is not used to measure claim severity. As a result, an external composite index, composed partly of construction cost index and the consumer price index is used for trending.

For liability insurance, separate trending of claim severity and claims frequency is common because many factors can affect them individually. Example, economic inflation or deflation over the course of payments can affect the average cost of a claim (severity). Meanwhile, legislative, regulatory or other external changes, such as modifications in rules governing claim settlement, can affect the number of losses (frequency).

In some lines, such as fire insurance, trending both losses and premiums is necessary. Losses are trended partly to reflect any effects on inflation on claims costs. But people also trend to increase the amount of property insurance purchases to reflect the increased values. This increases insurer premium revenue. So insurers trend both losses and premiums and offset the growth in losses with the growth in premiums.

**Premiums are also trended in other types of insurance for which the exposure units are affected by factors typically tied to inflation, like workers compensation (which uses payroll as its exposure base) and some general liability (which uses sales). But the trending problem exists in workers compensation insurance, because the benefits can be changed by legislation or a court decision unexpectedly. So a law amendment factor is used to adjust rates and losses. Actuaries can estimate the effects of a statutory benefit change on the losses that insurers will incur**.

For equipment breakdown insurance, trending is applied to the inspection and risk control services because they are a significant portion of the rate, often exceeding the pure premium.

**Large Loss Limitations**

**Unusual rate fluctuations can result from occasional large losses, whether from individual losses or accumulated smaller losses from a single event, such as a hurricane. In liability insurance, these fluctuations are controlled by using only basic limit losses in calculating incurred losses. Losses capped at a predetermined amount, such as $100,000 are an example of basic limit losses.**

Workers compensation insurance ratemaking follow a similar practice. Individual claims used for ratemaking must be lower than a specified amount. Another limitation applied to multiple claims arising from a single event. Both limitations vary over time and by state.

Loss limitations also apply in property insurance ratemaking. When a large single fire insurance loss occurs, only part of it is included in the ratemaking calculations in the state in which it occurred. The balance is spread over the rates of all states. The amount included in the sate rate depends on the fire insurance premium volume in that state.

**Most losses from catastrophic events are excluded from ratemaking data and replaced by a flat catastrophe charge. This charge is determined by catastrophe data collected over a long period to smooth the fluctuations that would otherwise result**. A catastrophe model which incorporates past experience with scientific theory, is often used to calculate an appropriate charge for these potential losses.

In addition, commercial insurers may have to quote a charge related to terrorism loss exposures.

**Credibility**

Credibility is a measure of the predictive ability of data. In ratemaking, the credibility of past loss data is important when projecting future losses. To be fully credible, ratemaking data must contain sufficient volume to provide an accurate estimate of the expected losses for the line, state, territory, and/or class being reviewed. The volatility of the loss data determines how much volume is needed to be fully credible – the higher the volatility, the more data that is required to provide a reasonable projection of future losses.

In auto insurance, advisory organizations and some larger insurers consider statewide loss data to be fully credible. But that data might be inappropriate for some smaller insurers that base rates solely on their own data.

When an advisory organization identifies territories and classes with loss data that is not credible, rates are calculated as a weighted average of the indicated rate for the territory or class and the statewide average rate for all classes and territories. The credibility factor indicates the amount of weight to give to the actual loss experience for the territory or class compared with an alternative source – in this case, the statewide average loss experience. A credibility factor is a number between 0 (no credibility) and 1 (full confidence).

For property insurance, because of the low frequency, advisory organizations might determine that even the statewide loss data is not credible. In that case, a three part weighted average could be used, combining the state loss data for the rating class, regional (multistate) loss data for the rating class, and state loss data for a major group encompassing several rating classes. Again, credibility factors are used as weights.

The pure premium for workers compensation insurance developed by the NCCI are composed of pure premium charges for medical and indemnity costs. Separate credibility standards exist for each of these categories.

**Increased Limits Factors**

Liability insurance coverage is provided at various limits. Actuaries have numerous ratemaking techniques for pricing coverage amounts in excess of the basic limit.

**The common way to establish rates for coverage greater than the basic limit is to develop increased limit factors. A base rate is first developed using losses capped at the basic limit. Increased limits factors can then be applied to the basic limit rate. Example, the additional charge to increase the general liability limit to $2M for any one occurrence might be expressed as 70% of the basic coverage limit rate, producing an increased limits factor of 1.70 from the original 1.00 rate.**

**Charges to increase liability limits frequently exceed 100 percent of the charge for basic limits, there are several reasons for this.**

* **Additional coverage purchased by the customer can be much higher than the basic limit**
* **Higher limits can also require a portion of the coverage to be reinsured, with the additional expense of reinsurance included in the rate**
* **Because large losses occur less frequently than small losses and take longer to settle, the variability of losses in higher coverage layers is greater than the basic limit losses and the credibility is lower. This greater variability requires a greater risk charge**

**8 – Loss Reserves and Analysis**

**Objective**: Analyze loss reserves in terms of purpose and types, importance of accuracy, and analysis techniques used by actuaries.

Insurer must hold the appropriate amount of loss reserves to ensure that they can pay valid claims and avoid insolvency, so it’s important to understand the different types of loss reserves and how to calculate them.

Adequate loss reserves provide assurance that an insured’s claim will be paid. They are generally the largest liability on an insurer’s balance sheet and a significant part of an insurer’s financial condition. An accurate estimation of the actual costs of business and ensures its ability to pay claims. Actuaries use various techniques to estimate the liability for future payments.

**Purpose of Loss Reserves**

Insurers are required by law to have reserves for losses that can reasonably assume they will incur. These reserves have to be able to cover both reported claims and claims that have occurred but have not yet been reported. Insurer may also have to make payments on current claims well into the future. An insurer must estimate these future payments in order to calculate its financial position, and creating reserves requires setting aside current income (premiums) to pay for losses in the future.

The liability an insurer carries on its books for future payments on incurred claims is commonly called a loss reserve. However, the liability is not just for payments of claimant’s losses; the insurer is also responsible for future loss adjustment expenses (LAE). Those expensed include both allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE).

An insurer’s senior management selects the amount of loss reserves the insurer must hold, and actuaries and other professionals provide estimates of unpaid claims to assist in the decision.

**Types of Loss Reserves**

**There are two principal types of loss reserves: Case reserves and bulk reserves.**

Case reserves represent the estimated loss value of a claim. The claims department usually sets these reserves, but the actuarial department might assist with complex claims. **Bulk reserves exist because insurers cannot identify specific claims with inadequate or excessive case reserves or predict which claims will be reopened**.

**Bulk (or aggregate) reserves are the provision insurers make for additional reserves. They can be a substantial part of an insurer’s liabilities. Bulk reserves can have these components;**

* **Incurred but not reported (IBNR) reserves**
* **Reserves for losses that have been reported but for which the established case reserves are inadequate (sometimes called incurred but not enough recorded (IBNER) reserves**
* **Reserves for claims that have been settled and then reopened**

**Importance of Accurate Loss Reserves**

Analyzing loss reserves determines whether the carried loss and LAE reserves can be expected to adequately cover the losses that have been incurred but not yet paid. The following parties may conduct this analysis for various reasons.

* The insurer’s auditors, to determine whether the insurers financial statements accurately indicate its financial condition and performance
* Management as part of its analysis of costs of doing business
* Rating agencies, on behalf of investors
* Regulators on behalf of policyholders, to ensure that claims will be paid

The national Association of Insurance Commissioners (NAIC) Annual Statement requires insurers to have their los reserves certified by an actuary or another qualified professional.

**Overestimating loss reserves (higher than ultimately paid) can lower an insurer’s financial strength rating, reduce statutory limits on premiums that can be written, or lead to dissolution of an insurer. If loss reserves are under estimated and future payments will exceed reserves, the insurer can become insolvent**.

**Analysis of Loss Reserves**

Actuaries analyze loss reserves using a variety of methods. In most cases, estimates are made of the losses to be paid on the exposures to date. The loss reserves is then estimated by subtracting payments to date. Separate projections of the reserve are sometimes required for known claims and for IBNR claims, and those results are added together. ALAE reserves may be estimated with r separately from the loss reserve estimate. ULAE reserves are usually analyzed separately.

Because reserve analysis is a projection of future events, any reserve estimate is inherently uncertain to some degree, but actuarially sound reserve estimates should be based on reasonable assumptions using accepted methodology. Even so, actuaries cannot guarantee that actual future payments will be at or near the estimate.

Among the most common methods used to estimate ultimate losses are the loss development method, expected loss ratio method, and bornhuetter-ferguson method.

**Loss Development – A Closer Look**

The loss development method assumes that future changes in losses will occur similarly as in the past. Because of the widespread use of the loss development method and underlying loss development triangles, it’s worth taking a closer look at this method. It’s also used to project ALAE, claims counts, and even premiums.

**The loss development method involves compiling the experience into a loss development triangle, calculating the age-to-age development factors, selecting the development factors to be used, and applying factors to experience to make projections**.

The loss development triangle is a table showing values for a group of claims at different points in time. The table is arranged so that it’s easy to see the values and the changes of different groups at similar ages of development. The claims are usually grouped by accident year or policy year.

This information shows the claims paid for each claim and each period. This information can be put into a cumulative paid loss as of calendar year end. As each period is added the information creates a triangle beginning with the 1st year and only one loss, followed by the second year showing what was paid for the first year and then add the continued claim payments for the first year and the additional claim payments for the new year, then the 3rd year is added and the triangle continues. This information makes it easier to compare the different years’ experience at the same age. This information create the loss development triangle.

This loss development triangle can be built up year after year.

The second step is calculating the age-to-age factors, is based on information presented in the triangle. The triangle provides an overview of how each accident year’s loss develop over time. Comparison between years is easier when looking at the change from one evaluation period to the next. For example, at 24 months, the losses paid for accident year 1 were 800, compared with 425 at 12 months. The ratio of the two values is 1.88 (800/425); so, losses increased by 88% form 12 – 24 months. This ratio is an age-to-age factor. Similar factors can be calculated for each accident year’s development producing a loss development triangle of age-to-age factors.

If the age-to-age factors down the column are relatively consistent, a pattern of development may be revealed that can be sued to estimate future development.

The third step is calculating the loss development factors to be used. Assume that the average factors show are a reasonable estimate of development. In an actual analysis, the factors selected might vary from the mean. For example, if the accident year multipliers indicated an increasing trend, the analyst might use selected values higher than the mean. The expected development from each age to the final value can be derived by multiplying the factors together.

The results are cumulative loss development factors that project from an age of development to a projected final value, or age-to-age ultimate factors.

Expected development factors to ultimate – Expected development from 36 to 48 months (final) = 1.00

Expected development from 24 months to final

= expected development from 24 – 36 months x expected development from 36 months to final

= 1.20 x 1.00 – 1.20

Expected development from 12 months to final

= expected development from 12 - 24 months x expected development from 24 months to final

= 1.75 x 1.20 = 2.10

In this case, the experience shows not further development. In some cases, development may appear to continue beyond the last age for which there is experience. For example, liability claims may take many years to settle. An indication of further development is that factors for the most mature periods are still significantly different from 1.00. In those cases, a tail factor would have to be estimated using other information to account for further development.

Finally, the factors can be used to project immature loss data to full maturity. The paid losses are multiplied by the respective factors to produce a projected ultimate loss.

An estimated loss reserve can be calculated by subtracting the current paid losses form the projected ultimate losses. But any changes in business practices or external conditions could affect the usefulness of this method. Such changes are changes in mix of business, policy limits purchased, and how case reserves are set. Also, large one time events would disrupt the historical pattern. In that case, there may be adjustments than can be made to the data, such as excluding catastrophe losses, which can correct for one time conditions. In the end, the power and usefulness of the development method more than offset these limitations in most circumstances.