Insurer Performance & Profit

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
A.3. Describe, analyze or design the information requirements for ratemaking related to premiums and demonstrate the use of premiums in ratemaking. *Range of weight: 4-8 percent*	**a. Organization of data: calendar year, policy year, accident year**
A.4. Describe, analyze, or design the information requirements for ratemaking related to loss and loss adjustment expense and demonstrate the use of loss and loss adjustment expenses in ratemaking. *Range of weight: 8-12 percent*	**a. Organization of the data: calendar year, policy year, accident year, report year** **h. Loss development**
B.1. Describe, analyze, and validate the information requirements for estimating unpaid claims. *Range of weight: 2-6 percent*	**a. Types of data and their sources** **b. Role of homogeneity and credibility of data in the process of estimating unpaid claims** **d. Organization of data: calendar year, accident year, policy year, underwriting year, report year**
B.3. Construct and appraise unpaid claims estimates using each of the following estimation techniques: • Development technique, including case outstanding technique • Expected claim technique • Bornhuetter-Ferguson technique • Cape Cod technique • Frequency-Severity techniques *Range of weight: 12-16 percent*	**h. Key terms: case outstanding, paid claims, reported claims, incurred but not reported, ultimate claims, claims related expenses, reported and closed claim counts, claim counts closed with no payment, insurance recoverables, exposures, experience period, maturity or age, and components of unpaid claim estimates**

This section will discuss how policy data, claims data, and accounting data can be aggregated and brought together by actuaries for use in measuring an insurer's profitability and performance.

Price, Cost, and Profit

For most products and services, the cost of creating the product or providing the service is known before the product or service is sold. Prices for these products and services are set to be equal to that cost plus a margin for profit. In equation form this is Price = Cost + Profit.

In insurance, the cost of the policy being sold may not be known until many years after the policy is sold, as there is uncertainty in how many claims occur (if any), when those claims will be reported and settled, and how much the claims will cost the insurer. Actuaries use methods to estimate the costs of insurance policies in two common capacities:

1. Ratemaking actuaries estimate costs of policies before they are sold and add a target profit in order to set prices. They essentially solve Price = Estimated Cost + Target Profit.

2. Reserving actuaries estimate costs of policies after they are sold so that those costs can be subtracted from revenue to measure profit. They essentially solve Estimated Profit = Price - Estimated Cost.

The Fundamental Insurance Equation

Putting the economic relationship relating Price, Cost, and Profit into insurance specific terms results in the Fundamental Insurance Equation:

Premium = Losses + LAE + UW Expenses + UW Profit

Premium is analogous to Price, as premium is the price of the insurance product.

Cost is analogous to (Losses + LAE + UW Expenses). While some UW expense and ULAE costs may be known before the policy is sold, the majority of costs are uncertain and must be estimated.

UW Profit, also known as Operating Income, is analogous to Profit. Note that insurers can also profit from investments. The total profit for an insurer is:

Total Profit = UW Profit + Net Investment Income

An insurer may set its UW Profit targets depending on how well its investments are performing. With higher investment returns, insurers may be willing to write policies with a negative UW Profit margin, since they can still achieve a positive total profit.

Restating the roles of ratemaking and reserving actuaries in terms of the fundamental insurance equation:

1. Ratemaking solves: Premium = Estimated (Losses + LAE + UW Expenses) + Target UW Profit
2. Reserving solves: Estimated UW Profit = Premium - Estimated (Losses + LAE + UW Expenses)

Cost and Premium Estimates

Since losses are uncertain and can develop over time, their final value must be estimated in advance in order to set prices or measure profit. This estimated amount is called **Ultimate Loss**, and is defined as the final amount required to close and settle a claim or group of claims.

Ultimate losses have 3 components:

1. Reported Losses, which we've seen equals paid losses + case reserves.
2. **Incurred But Not Reported (IBNR) Reserve**: This is the amount estimated to ultimately settle claims that have occurred, but have not yet been reported to the insurer. This may also be called "pure IBNR".
3. **Incurred But Not Enough Reported (IBNER) Reserve**: This is an estimate of the development of the Reported Losses for claims that have been reported to the insurer. This is also sometimes called the "development on known claims" or "Reserved But Not Enough (RBNE) Reserve".

Estimated Ultimate Losses = Reported Losses + IBNR Reserve + IBNER Reserve

In practice, IBNR and IBNER are often combined together and estimated on a combined basis, in which case they may still (confusingly) be referred to as IBNR.

Note that premiums and LAE may also develop over time and may need to be estimated in advance. Ultimate premiums or ultimate LAE can be estimated in similar ways to ultimate losses.

Granularity

Now that we know the fundamental insurance equation and the roles of ratemaking and reserving actuaries in using it, we can discuss the level of granularity at which the equation is used. We can start with the level of granularity needed for rates and profit measurements.

In ratemaking, the equation should be balanced at the aggregate level across all policies that the insurer sells, so that the insurer stands to make its overall target UW profit. Furthermore, the equation should also be balanced at the smallest level of granularity that is statistically reliable to ensure that rates are fair for different customers. For example, a higher risk insured should pay higher premiums than a lower risk insured. This level of granularity might be a subgroup of policies within a line of business, an individual policy, or a coverage on an individual policy.

In reserving, the equation must be used to measure profit at the level needed for financial reporting, which is generally at the line of business by accident year level. Furthermore, the equation can be used to measure profit at any other levels of granularity for which the insurer wishes to make business decisions.

Regardless of whether actuaries are working in ratemaking or reserving, actuaries will need to estimate the insurer's costs, and these estimates can be made more accurate by subdividing the data into groups of policies or claims that exhibit similar characteristics. Actuaries will generally group data to the level that best balances homogeneity of the data and credibility of the data, while considering the resources available to complete the analysis in a timely manner.

For example, it may be more accurate to estimate Bodily Injury Liability ultimate losses separately from Property Damage Liability ultimate losses, even though those 2 coverages are typically always combined in pricing and in financial reporting.

Using Data for Ratemaking and Reserving

The policy, claims, and accounting data previously discussed are all typically used in ratemaking and reserving. Adjustments such as bringing the data to a common currency, merging any data sets if necessary, and aggregating the data to an appropriate level of granularity for the analysis will be made before beginning any analysis.

There are 3 main considerations in deciding what time method to use in grouping the data:

1. **Accurately matching premiums and exposures to losses.** For example, losses paid in a given calendar year may have come from policies from multiple accident years, policy years, and report years.
2. **Using the most recent data available.** This can also be described as using the most responsive data. For example, calendar year results are known immediately after the year is over, while accident year, policy year, and report year all develop over time.
3. **Minimizing the cost of data collection and retrieval.**

Really, the first 2 mentioned above are of primary importance, while the 3rd item just represents a potential barrier in practice.

Now let's review the different time methods and the advantages and disadvantages of each in ratemaking and reserving.

Time Methods in Analyses

1. **Calendar Year**: This method considers all policies and loss transactions during the year. The main advantage of using calendar year data is that there is no development, so results are final immediately after the year is over. Calendar year data is also readily available since it is required for financial reporting. The main disadvantage of using calendar year data is that it provides a poor match in timing between premiums/exposures and losses.
2. **Calendar/Accident Year**: This method combines calendar year premium and exposure data with accident year claims data. This is the most commonly used method in ratemaking and reserving analyses. This method presents a better match in timing of premiums/exposures and losses than calendar year. However, future development must be estimated since accident year losses can develop over time.
3. **Accident Year**: This is a slight modification of calendar/accident year, with the only difference being that premium audits taking place after the calendar year is over are incorporated into the premium and exposure data. As a result, the premium and exposure data is subject to development and must be estimated in addition to the loss data. However, it does provide a truer match of premiums/exposures to losses than calendar/accident year.
4. **Policy Year**: This method considers all premiums, exposures, and losses from policies with effective dates during the year. The main advantage of using policy year data is that it provides a true match between premiums/exposures and losses. The main disadvantage is that policy year data takes longer to develop than accident year data. Reinsurers also use **Underwriting Year**, which is similar to policy year but it is based on the year that the reinsurance policy became effective.
5. **Report Year**: This method groups loss data based on the date that claims are reported. This is used primarily for claims-made policies, which provide coverage based on the date the claim is reported instead of the accident date. An advantage of report year data is that the number of claims is known at the end of the year. A disadvantage is that report year is useful in estimating IBNER, but not as useful in estimating IBNR.

Different methods also work better in different situations:

- Using accident year loss data is preferable when you want to isolate major claim events such as catastrophes.
- Using policy year data is preferable when you want to isolate policy or underwriting changes, such as a change in policy limits or deductibles being written.
- Using report year data is preferable when you want to isolate changes in claims practices, such as case reserving adequacy.
- Using quarterly data is preferable to using yearly data when a book of business is growing or shrinking rapidly.

Data Quality

When performing any type of analysis, actuaries have certain professional requirements in dealing with the data involved. Actuarial Standard of Practice #23 (not on the syllabus) outlines considerations for actuaries in selecting and using data for analyses, including determining whether a dataset is appropriate and reliable for the intended analysis and documenting any issues with the data and assumptions made in using the data.

In verifying that a dataset is reliable, actuaries should review the following:

- **Consistency with financial statement data**: How close is the match?
- **Consistency with data from prior analyses**: How close is the match?
- **Data reasonableness**: Do values make sense?
- **Data definitions**: Do you know what each data field represents?

Data quality is usually more of an issue for claims data compared with policy or accounting data since claims data is manually entered by claims adjusters, and is thus subject to human error.

Some examples of actual claims data quality issues I've seen in practice include:

- An accident year typed in wrong by a claims adjuster (e.g., 2020 instead of 2010).
- A new claim being created with the correct coding after a prior claim was created with incorrect coding, resulting in 2 claims in the data where there should have been only 1.
- Claims for a coverage that didn't show on the policy in the policy data.
- A case reserve accidentally being set with 2 extra zeros ($10M instead of $100k).

Some of these and other data quality issues can be caught or even prevented with data management rules built into computer systems. Actuaries should be able to use their judgment to recommend such rules, or should know how to deal with these types of issues in their analyses.

Some possible solutions to dealing with flawed claims data include:

- Include the flawed data if you don't expect it to materially impact the results of the analysis.
- Ignore claims with poor data quality (if you know which claims have issues). This may be practical for an analysis, but accounting can't chose to ignore numbers in financial reporting.
- Make assumptions and create data cleansing rules in the analysis.

Whatever approach is taken, the actuary should document their decisions and any approximations or assumptions made.

External Data Sources

When performing an analysis for a large insurer, actuaries will primarily use the insurer's internal data, but may choose to use external data to supplement their analyses. Actuaries working for small insurers or for large insurers entering a new market may need to turn to external sources to obtain the data sufficient for an analysis. Insurers of all sizes may want to use external data as a benchmark against which to compare their own results.

Types of external data sources include:

1. **Statistical plans**: These plans aggregate data across companies and produce analyses or rates that companies can use. Two major organizations in the U.S. that provide this type of data are the National Council on Compensation Insurance (NCCI) and the Insurance Services Office (ISO).
2. **Other aggregated industry data**: Examples include the Fast Track Monitoring system, which creates reports on industry level loss trends, and the Highway Loss Data Institute (HLDI), which provides loss information by type of vehicle in auto insurance.
3. **Competitor rate filings & manuals**: These may be obtained from public records at state insurance departments. These can be used by an insurer in setting their own rates.
4. **Other 3rd party data**: This might include economic or geo-demographic data. For example, Consumer Price Indices (CPIs) for things like medical costs can be used to better understand inflation in an insurer's own loss data. Other examples of data here would include weather data, credit data, crime data, DMV records, etc.

When using external data, significant caution needs to be taken in understanding whether the data is relevant or comparable for the insurer. Data may be different for different insurance companies because of differences in products offered, coverage definitions, underwriting criteria, expense levels, claims practices, claims coding, mix of business, etc.

Basic Insurance Ratios

A number of ratios are commonly used to measure the performance of insurance companies. The numerators and denominators of the ratios can usually be aggregated with the different measures and time methods we've seen in the policy and claim data sections, so attention should be paid to how a specific instance of the ratio is being used.

Frequency

Frequency, also called claims frequency, is the rate at which claims occur.

$$\text{Frequency} = \frac{\text{Number of Claims}}{\text{Number of Exposures}}$$

The most common scenario is to use earned exposures in the denominator and reported or ultimate claim counts in the numerator.

Changes in frequency can help identify trends in claims occurrence and insurance utilization as well as measure the effectiveness of underwriting changes. As an example, during periods of significantly high gas prices, frequency tends to decrease for most personal auto coverages as people drive less and thus get into less accidents.

Severity

Severity is the average loss per claim.

$$\text{Severity} = \frac{\text{Losses}}{\text{Number of Claims}}$$

Severity is often calculated many different ways in practice, and the differences may help build an understanding of changes in the loss portfolio. Furthermore, ALAE may or may not be included in severity measures with Losses.

Changes in inflation or claims handling procedures may show up as changes in claim severity over time.

Pure Premium

Pure premium, also known as loss cost, is the average loss per exposure.

$$\text{Pure Premium} = \frac{\text{Losses}}{\text{Number of Exposures}} = \frac{\text{Number of Claims}}{\text{Number of Exposures}} \times \frac{\text{Losses}}{\text{Number of Claims}} = \text{Frequency} \times \text{Severity}$$

The most common scenario is to use earned exposures in the denominator and reported or ultimate losses in the numerator.

Average Premium

Average Premium is the average premium per exposure.

$$\text{Average Premium} = \frac{\text{Premium}}{\text{Number of Exposures}}$$

The numerator and denominator for average premium should be on the same basis (written, earned, unearned, or in-force).

Average premium changes come from both rate changes made by the insurer and changes in the mix of business written. For example, if an auto insurer gives a discount to married drivers, and a higher percent of insureds are getting married over time, then a higher percent of insureds will get the discount and the average premium will decrease over time.

Loss Ratio

Loss Ratio is the portion of each premium dollar that is used to pay losses.

$$\text{Loss Ratio} = \frac{\text{Losses}}{\text{Premium}} = \frac{\text{Pure Premium}}{\text{Average Premium}}$$

The most common scenario is to use earned premium in the denominator and reported or ultimate losses in the numerator.

This is the primary measure that insurers look at to monitor their rate adequacy.

LAE Ratio

LAE Ratio is the ratio of LAE to Losses.

$$\text{LAE Ratio} = \frac{\text{LAE}}{\text{Losses}}$$

Note that in practice the term "LAE Ratio" may also be used as LAE divided by Premium, so it is important to clarify which denominator is being used.

This ratio is used to monitor claims department costs.

Underwriting Expense Ratio

UW Expense Ratio is the portion of each premium dollar that is used to pay underwriting expenses.

$$\text{UW Expense Ratio} = \frac{\text{UW Expenses}}{\text{Premium}}$$

Usually, insurers will compare the underwriting expenses that are incurred at the start of policy terms (i.e., commissions, premium taxes, etc.) to written premium and expenses that are incurred over the life of the policy to earned premium. In these cases, the UW Expense Ratio is:

$$\text{UW Expense Ratio} = \frac{\text{Commissions and brokerage + Other acquisition + Taxes, licenses, and fees}}{\text{Written Premium}} + \frac{\text{General expenses}}{\text{Earned Premium}}$$

Operating Expense Ratio

Operating Expense Ratio is the portion of each premium dollar that is used to pay underwriting expenses and LAE.

$$\text{Operating Expense Ratio} = \text{UW Expense Ratio} + \frac{\text{LAE}}{\text{Earned Premium}}$$

Combined Ratio

Combined Ratio is the portion of each premium dollar that is used to pay all underwriting costs.

$$\text{Combined Ratio} = \text{Loss Ratio} + \frac{\text{LAE}}{\text{Earned Premium}} + \frac{\text{UW Expenses}}{\text{Written Premium}}$$

For companies that relate general expenses to earned premium, the formula becomes:

$$\text{Combined Ratio} = \text{Loss Ratio} + \text{Operating Expense Ratio}$$

The combined ratio is the most common measure of overall underwriting profit for insurers. If you divide the fundamental insurance equation by premium, you can see that UW Profit as a percentage of Premium is equal to 1 - Combined Ratio. For example, a Combined Ratio of 98% means that 2 cents of every premium dollar is going to underwriting profit.

Retention Ratio

Retention Ratio is the percent of current insureds that renew their policies at policy renewal.

$$\text{Retention Ratio} = \frac{\text{Number of Policies Renewed}}{\text{Number of Potential Renewal Policies}}$$

How this is measured in practice varies across companies. For example, some insurers omit policies that are canceled by the insurer.

Retention ratios are monitored as a competitiveness measure, and are watched closely after rate changes or significant changes in service by an insurer. They are also used in projecting future premiums.

Close Ratio

Close Ratio is the percent of quotes given to potential insureds that are converted into policies. The close ratio may also be referred to as the hit ratio, the quote-to-close ratio, or the conversion rate.

$$\text{Close Ratio} = \frac{\text{Number of Accepted Quotes}}{\text{Number of Quotes}}$$

How this is measured in practice varies across companies. For example, some insurers may count multiple quote iterations for the same customer as one quote.

Close ratios are used as a competitiveness measure.

Problem Knowledge Checklist

1. The Fundamental Insurance Equation
    - Be able to write out the fundamental insurance equation.
    - Be able to describe how the fundamental insurance equation relates to the standard economic formula Price = Cost + Profit.
    - Be able to define the components of Ultimate Losses.
    - Be able to describe why the fundamental insurance equation should be balanced at both the aggregate and individual levels.
2. Data for Ratemaking and Reserving
    - Be able to list the 3 main considerations in deciding what time method to use in grouping the data.
    - Be able to list the time methods discussed, along with the advantages and disadvantages of each according to the 3 main considerations.
    - Be able to give examples of real scenarios in which each time method would be preferable (e.g., using accident year to isolate catastrophes).
    - Be able to briefly describe 4 things actuaries should review in verifying that a dataset is reliable.
    - Be able to briefly describe 4 types of external data sources and how they can be used.
    - Be able to explain why caution needs to be taken when using external data.
3. Basic Insurance Ratios
    - Be able to calculate each of the 11 basic insurance ratios discussed.
    - Be able to briefly describe and give an example of how each ratio can be used in practice.