Exam 5 High-Level Summaries

Spring 2026 Edition

CAS Exam 5 Online Course

Rising Fellow

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CAS Principles of Ratemaking & ASOPs

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Ratemaking – Ch. 1

Introduction

Overview

The goal of ratemaking is to balance the fundamental insurance equation (below) by setting prospective rates so that the premium is expected to cover all costs and achieve the target underwriting profit.

$$\boxed{Premium = Losses + LAE + UW\ Expenses + UW\ Profit}$$

Key Considerations

Ratemaking is Prospective

- Rates should be set so that the premium is expected to achieve the target profit **during the period the rates will be in effect.**

Overall & Individual Balance

- **Equilibrium at an aggregate level** – Total premium of *all policies* covers expected losses, expenses, and achieves the target profit
- **Equilibrium at an individual level** – *Individual policies* should be charged premiums appropriate to their level of risk of loss

CAS Principles of Ratemaking

1. "A rate is an estimate of the expected value of future costs"
2. "A rate provides for all costs associated with the transfer of risk"
3. "A rate provides for the costs associated with an individual risk transfer"

Basic Insurance Ratios

Frequency and Severity

- Frequency changes can help identify industry trends and the effectiveness of underwriting actions
- Severity changes reflect loss trends and can highlight the impact of changes in claims handling

$$\boxed{Frequency = \frac{\#Claims}{\#Exposures}} \qquad \boxed{Severity = \frac{Losses}{\#Claims}}$$

Pure Premium (Loss Cost)

- Pure premium changes reflect industry trends in loss costs due to frequency and severity changes

$$\boxed{Pure\ Premium = \frac{Losses}{\#Exposures} = Frequency \times Severity}$$

Average Premium

- Average premium changes, adjusted for rate changes, can indicate changes in the mix of business

$$\boxed{Average\ Premium = \frac{Premium}{\#Exposures}}$$

Loss Ratio and LAE Ratio

- The loss and LAE ratio is a key measure of the rate adequacy overall and for key segments
- The LAE ratio shows whether claim settlement costs are stable or not

$$\boxed{Loss\ Ratio = \frac{Losses}{Premium}} \qquad \boxed{LAE\ Ratio = \frac{LAE}{Losses}}$$

Underwriting Expense Ratio

- Changes in the underwriting ratio can be compared to general inflation, and the ratio can be benchmarked against other companies

$$\boxed{UW\ Expense\ Ratio = \frac{UW\ Expenses}{Premium} = \frac{Commission, Acquisition, Tax}{Written\ Premium} + \frac{General\ Expense}{Earned\ Premium}}$$

Operating Expense Ratio

- The OER is used to monitor operational expenses and is a key factor in overall profitability

$$\boxed{OER = UW\ Expense\ Ratio + \frac{LAE}{Earned\ Premium}}$$

Combined Ratio

- The combined ratio is the primary measure of the profitability of a book of business

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

$$\boxed{Combined\ Ratio = Loss\ Ratio + OER}$$

Retention Ratio and Close Ratio

- Retention ratios are used to gauge the competitiveness of rates for current customers
- Close ratios are used to gauge the competitiveness of rates for new business

$$\boxed{Retention\ Ratio = \frac{\#Policies\ Renewed}{\#Potential\ Renewal\ Policies}} \qquad \boxed{Close\ Ratio = \frac{\#Accepted\ Quotes}{\#Quotes}}$$

Ratemaking – Ch. 3

Ratemaking Data

Overview

Insurers must maintain high-quality policy and claims data for accurate ratemaking. Data is aggregated in different ways (calendar year, accident year, etc.) and at different levels of granularity for different ratemaking analyses (overall rate analysis or classification analysis).

Internal Data

Risk Data

- **Policy Database**
  - Records for individual policies
  - Fields for each record (policy/risk ID, dates, written premium/exposure, rating characteristics)
- **Claims Database**
  - Records for specific claims
  - Fields for each record (policy/risk ID, claim ID/status, paid loss, case reserve, ALAE, Sal/Sub)

Accounting Data

- Underwriting expenses and ULAE tracked at an aggregate level

Data Aggregation

The purposes of data aggregation are to:

- Accurately match losses and premiums for policies
- Use the most recent data available
- Minimize the cost of data collection and retrieval

Calendar Year Aggregation

Calendar year aggregation considers **transactions that occur during the calendar year**, regardless of the policy effective date, accident date, or report date.

- Appropriate for lines of business where losses are reported and settled quickly

Advantages	Disadvantages
• Data is available quickly and is fixed at year-end	• Mismatch in timing between premium and losses
• No additional expense to aggregate	• May not be appropriate for lines of business where losses are reported and settled relatively slowly.

Accident Year Aggregation

Accident year aggregation includes losses for **accidents that occurred during the accident year**, regardless of when the policy was issued or the claim was reported. Premium and exposures are aggregated in the same way as calendar year.

Advantages	Disadvantages
• Better match of premium and losses than calendar year aggregation	• Future development on known losses needs to be estimated

Policy Year Aggregation

Policy year aggregation includes **transactions on policies that were written during the policy year**, regardless of when the claim occurred or when it was reported, reserved, or paid. Premium and exposures aren't fixed until after all policies written during the policy year have expired.

Advantages	Disadvantages
• The best match between losses and premium	• Data takes longer to develop than both calendar year and accident year

Report Year Aggregation

Report year aggregation includes **losses on claims that are reported during the report year**, as opposed to loss occurrence date.

- Appropriate for claims-made policies

External Data

External data is used for new lines of business or to supplement internal data. Types of external data include:

- Statistical Plans
- Other Aggregated Industry Data
- Competitor Rate Filings and Manuals
- Other Third-Party Data

Overview

Exposures are the basic unit of risk, and a base rate is a price per unit of exposure. An exposure base should be proportional to expected loss, practical to use, and consistent over time.

Criteria for Exposure Bases

- **Directly proportional to expected loss**
- **Practical to use**
    - Objective
    - Relatively easy and inexpensive to verify
    - Can't be manipulated by policyholders
- **Historical precedence** – Changes could result in:
    - Large premium swings to individual policyholders
    - Required changes to the rating algorithm
    - Significant data adjustments

Common Exposure Bases

Line of Business	**Exposure Bases**
Personal Auto	Earned Car Year
Homeowners	Earned House Year
Workers' Compensation	Payroll
Commercial General Liability	Sales Revenue, Square Footage
Commercial Business Property	Amount of Insurance Coverage
Physician's Professional Liability	Number of Physician Years
Professional Liability	Number of Professionals
Personal Articles Floater	Value of Item

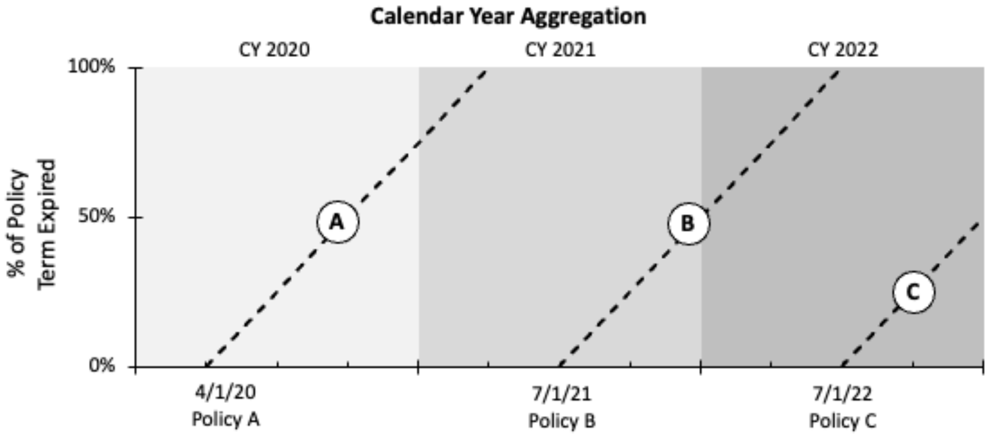
Exposures for Large Commercial Risks

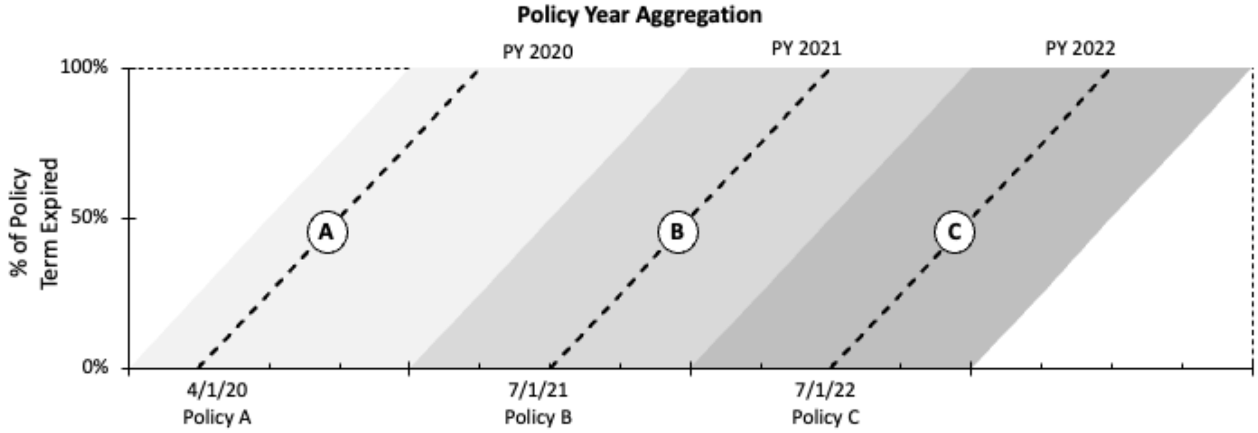
- **Composite Rating** – Different exposure bases by sub-coverage with a proxy exposure measure to determine the overall exposure change for a premium audit
- **Loss-Rated Composite Rating** – Premium is calculated using the individual risk's historical loss experience

Exposure Aggregation

Methods of Aggregation

- **Calendar Year** - Includes exposures during the calendar year, regardless of the effective date
- **Policy Year** - Includes exposures from policies written during the policy year





Exposure Definitions

- **Written** – Total exposures written during a specified time period
- **Earned** – Portion of written exposures for which coverage has already been provided

$$\boxed{CY\ Earned\ Exposures = \#Exposures \times \%Earned}$$

$$\boxed{PY\ Earned\ Exposures = \#Exposures \times \%Earned\ by\ as\text{-}of\text{-}date}$$

- **Unearned** – Portion of written exposures for which coverage has not yet been provided

$$\boxed{CY\ Unearned_{End\ CY} = CY\ Written - CY\ Earned + CY\ Unearned_{Beg.\ CY}}$$

$$\boxed{PY\ Unearned = PY\ Written - PY\ Earned}$$

- **In-Force** – Snapshot of the number of insured exposures (or risk units) exposed to having a claim at a given point in time

Other Issues

- **Policy Cancellations and Modifications**
    - Calendar Year – The written exposure for the cancellation/modification contributes to the calendar year of the ***transaction date***
    - Policy Year – The written exposure for the cancellation/modification contributes to the policy year of the ***original policy effective date***
- **Uneven Earning Pattern** – For lines of business with uneven earning patterns, calculate earned exposures and premiums based on the earning pattern, not the percent of the policy term exposed.
- **Semi-Annual Policies** – Each policy counts as 50% of a written exposure (0.5 years)

Calculating Blocks of Exposures

For summarized data, assume that all policies are written at the **mid-point of the time period**.

- This approximation assumes policies are uniformly written during each time period, which may not be appropriate for longer time periods (quarters or years)

Exposure Trend

If an exposure basis is inflation-sensitive (ex. payroll or sales), historical exposures should be projected to the future period in which the rates will be in effect.

Recipes for Calculation Problems

- Aggregating Exposures

Ratemaking – Ch. 5

Premium

Overview

The loss ratio method of ratemaking indicates the percentage rate change required to balance the fundamental insurance equation. A key input to this is the historical earned premium at current rate level projected to the future policy period. To calculate this, we need to adjust historical premium in three ways:

- On-leveling premium to current rates
- Developing premium to ultimate (if necessary)
- Trending premium to the future policy period

Premium Aggregation

Premium (written/earned/unearned/in-force) is aggregated in the same way as aggregating exposures.

For in-force premium, use the full-term premium for the policy that is in-force at the as of date when there are mid-term adjustments and different policy term lengths.

Adjustment 1 – On-Leveling Premium

On-leveling adjusts historical premiums that were written at different rate levels to current rates.

Method 1 – Extension of Exposures

Rerate all *individual policies* written in the historical experience period with the *current rating algorithm*. This restates the historical premium to current rates.

Advantages	Disadvantages
• Most accurate current rate level method	• Requires detailed data - rating characteristics for all policies in the historical period • Difficult to determine the debits/credits that would be applied under current rating guidelines

Method 2 – Parallelogram Method

Adjust *aggregated premiums* by applying an *average on-level factor* to historical premiums to approximate the on-level premium. There are two problems with this approach:

Problem 1 – It assumes policies are written evenly throughout the year

- This assumption isn't always valid, especially for seasonal lines of business
    - The parallelogram method can still be used with refined time periods (months/quarters)

Problem 2 – It applies at the aggregate level with overall average rate changes

- If past rate changes varied by class (class factors were modified), then premiums at the class level won't be properly on-leveled and can't be used for classification ratemaking analysis

Adjustment 2 – Premium Development

Premium development adjusts historical premiums to their ultimate amount. This is generally *only for policy year* data because calendar year data is fixed at year-end.

This is necessary in two common situations:

- Incomplete policy years of premium data
- Lines of business with premium audits

Adjustment 3 – Premium Trend

Premium trend adjusts historical on-level premiums to expected levels for the *future policy period*.

Exposure trend affects premium if exposures are inflation-sensitive. Beyond inflation, premium trend reflects changes to average written premium over time due to distributional changes in the mix of policies.

Distributional changes include:

- **Gradual changes in rating characteristics** (ex. gradual shift from sedans to SUVs/trucks)
- **Coverage changes** (ex. moving all policies to a higher deductible – a one-time change)
- **Portfolio purchases** (ex. a company acquires a book from another company – a one-time change)

Guidelines for Selecting a Premium Trend

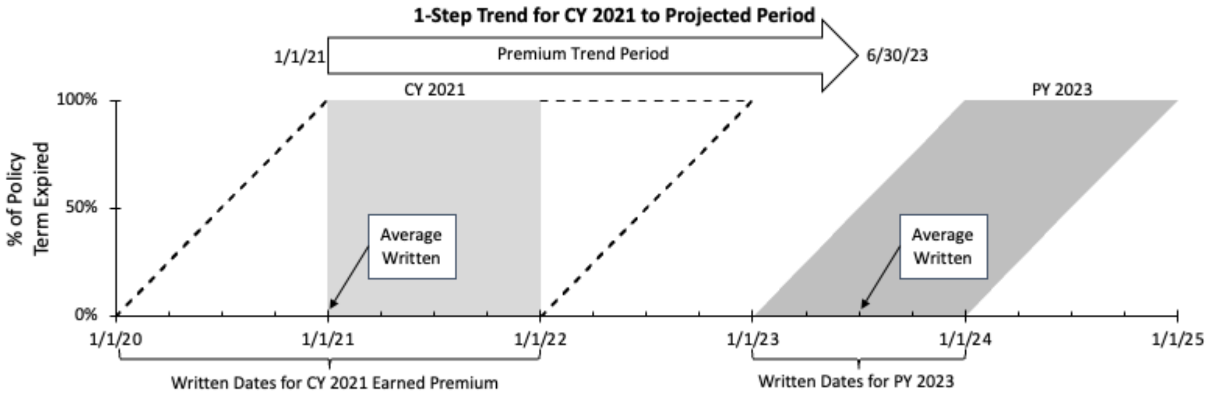
- Use *average premium* per exposure
- Use *written premium* aggregated at *quarterly* time periods when possible
- Use *on-level premium* to avoid double-counting the effect of rate changes

Method 1 – One-Step Trend

Trend earned premium from historical levels to expected levels in the future policy period using one fixed trend rate.

$$\boxed{1\text{-}Step\ Trend\ Period = Historical\ Average\ Written\ Date\ \rightarrow\ Effective\ Average\ Written\ Date}$$

$$\boxed{Premium\ Trend\ Factor = (1 + trend)^t}$$


1-Step Trend for CY 2021 to Projected Period
1/1/21
Premium Trend Period
6/30/23
CY 2021
PY 2023
100%
50%
0%
% of Policy Term Expired
Average Written
Average Written
1/1/20
1/1/21
1/1/22
1/1/23
1/1/24
1/1/25
Written Dates for CY 2021 Earned Premium
Written Dates for PY 2023

Method 2 – Two-Step Trend

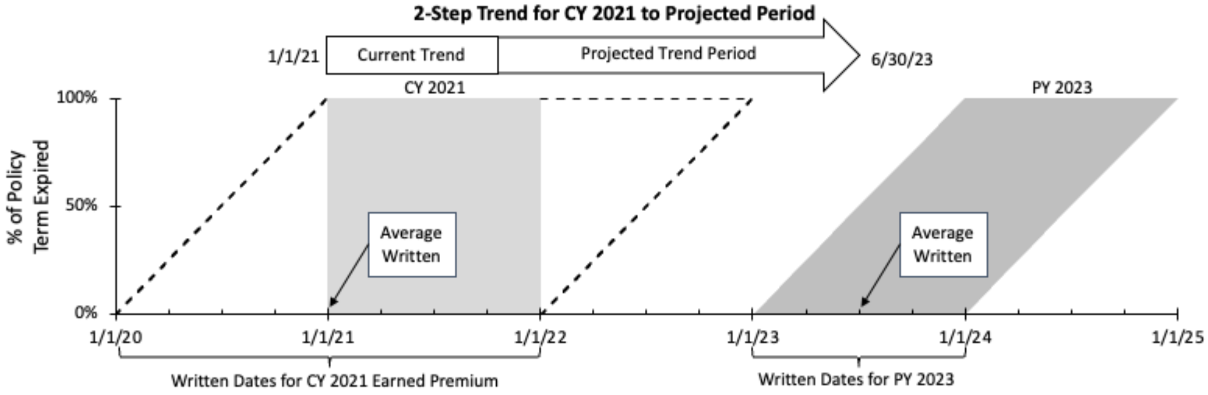
Use the two-step trend method when the ***historical trend*** is significantly different from the expected ***future trend***. For example, this may be necessary when there are one-time distributional changes.

- Step 1 adjusts ***historical*** earned premiums to the ***current*** average premium level
- Step 2 adjusts from ***current levels*** to the ***projected period*** average premium level

$$\boxed{Current\ Trend\ Factor = \frac{Latest\ Average\ WP\ at\ CRL}{Historical\ Average\ EP\ at\ CRL}}$$

$$\boxed{Projected\ Trend\ Period = Latest\ Average\ Written\ Date\ \rightarrow\ Effective\ Average\ Written\ Date}$$

$$\boxed{Projected\ Trend\ Factor = (1 + projected\ trend)^t}$$


2-Step Trend for CY 2021 to Projected Period
1/1/21
Current Trend
Projected Trend Period
6/30/23
CY 2021
PY 2023
100%
50%
0%
% of Policy Term Expired
Average Written
Average Written
1/1/20
1/1/21
1/1/22
1/1/23
1/1/24
1/1/25
Written Dates for CY 2021 Earned Premium
Written Dates for PY 2023

Projected Premium at Current Rate Level

Calculate the projected earned premium at current rate level by applying all the adjustments. Then, use this in the loss ratio method. Below is a general formula:

$$Projected\ EP\ at\ CRL = EP \times OnLevel\ Factor \times Premium\ Dev\ Factor \times Premium\ Trend\ Factor$$

For most problems, premium development isn't necessary.