7.1 → Ratemaking principles, considerations, & adjustments

7.1.0 → overview

→ Ratemaking is the process of determining the premium so that the fundamental insurance equation is balanced

premium = losses + LAE + UW Expenses + UW profit

7.1.1 → Ratemaking principles & considerations

→ Ratemaking principles → Rates charged by insurance companies should be developed by following these four principles:

→ Principle 1 → A rate is an estimate of the expected value of future costs

→ Principle 2 → A rate provides for all costs associated w/ the transfer of risk (ie balance at aggregate level)

→ Principle 3 → A rate provides for the costs associated w/ an individual risk transfer (ie balance at individual level)

→ principle 4 → A rate is reasonable & not excessive, inadequate, or unfairly discriminatory if it is an actuarially sound estimate of the expected value of all future costs associated w/ an individual risk transfer

→ Ratemaking considerations → Things to take into account when developing ratemaking methodologies

→ Exposure units, data, organization of data, influences on data, adjustments to data, Homogeneity, credibility, classification plans, individual risk rating, actuarial judgement

→ Influences on data → three things to be considered

→ policy provisions, mix of business, operational changes, other influences

→ Evaluating & adjusting ratemaking data → Adjustments to make to ensure the data reflects anticipated future costs accurately

→ shock losses, reinsurance, benefit & rate adjustments, development, trends, expenses, profit & contingency provision

7.1.2 → Shock losses

→ Overview → historical losses need several adjustments before they can be used for ratemaking, including:

→ Replacing extraordinary events in the historical data w/ long term expectations
→ Adjusting losses for changes in coverage or benefits, including changes required by law
→ Developing incurred losses to their ultimate settlement value
→ Trending losses to reflect the benefit & cost levels expected during the period the rates will be in effect

→ There isn't a specific order in which these adjustments need to be made, but the order should still be considered so that the proper adjustments are made. For instance, if the long term expectation for extraordinary losses has already been trended to the period the rates will be in effect, this expectation should not be added to historical losses until those losses have also been trended to the same period.

→ Pricing based on occurrences of shock losses

→ If no shock losses occur, prices will be an underestimation of costs

→ If shock losses do occur, prices will be an overestimation of costs

→ Adjusting for shock losses

→ When estimating future losses for ratemaking, it is common to make an adjustment for shock losses. The first step is to remove or minimize the impact of shock losses. Multiple ways to accomplish this include:

→ Excluding shock losses entirely
→ Capping all losses based on the maximum amount of insurance offered, typically referred to as the basic limit, or the limit associated w/ the base rate.
→ Capping losses at a different large loss threshold

→ If shock losses are removed entirely, the remaining losses are referred to as non-shock losses.

→ If shock losses are capped at a threshold, then only the portion of losses above that threshold, referred to as excess losses, will be removed. The remaining losses are known as non-excess losses.

→ The second step when adjusting for shock losses is to modify the remaining losses to include a provision for either expected shock losses or expected excess losses.

→ First need to consider two conflicting goals though when determining the threshold

→ 1) Include as many losses as possible
→ 2) minimize volatility in the ratemaking analysis

→ Determining shock loss provision

→ once a threshold is set for excluding or capping shock losses, a provision for shock losses can be calculated using the following steps:

1) Separate all losses into excess losses & non-excess losses
2) Sum the excess losses
3) Sum the non-excess losses
4) Calculate the ratio of excess losses to non-excess losses
5) Calculate the excess loss loading factor as 1 plus the ratio found above.

→ Then this factor is multiplied to the historical non-excess losses to account for the long term average expected shock loss.

→ Problem solving

→ In general: ratio = $\frac{\text{\$ losses adjusting for}}{\text{\$ non c...> losses}}$

factor = 1 + ratio

Year i adj losses = non c...> losses x factor

7.1.3 → Catastrophe data

→ Adjusting for catastrophes

→ To adjust for catastrophes when projecting future losses for ratemaking, actual catastrophe losses can be replaced by the average expected cat loss.

→ the method for determining the expected cat loss can vary by the type of insurance & the type of cat loss. Cat losses are typically broken down into the following two types:

1) non-modeled cat losses
2) modeled cat losses

→ non-modeled cat analysis is used for events that occur somewhat regularly over a period of many year, like hail storms.

→ In contrast, modeled catastrophe analysis is used for events that occur very infrequently but that result in high severity claims, like hurricanes or earthquakes

→ Not covered, but if given, need to use ⇒ Total cat provision = non-modeled cat Pure Premium + modeled cat loss Pure Premium

→ Determining non-modeled cat loss provision

→ Method 1: cat loss loading factor

→ one method for setting the non-modeled cat loss provision is to follow the same process used for the shock loss provision.

1) Sum the cat losses
2) Sum the non-cat losses
3) Calculate the ratio of cat losses to non-cat losses
4) Calculate the cat loss loading factor as 1 plus the ratio found above

→ Then, multiply non-cat losses used in the ratemaking analysis by the factor above to incorporate the long-term average expected non-modeled cat loss.

→ Method 2: Cat loss pure premium

→ A different method for incorporating non-modeled cat losses is to develop a pure premium or loss ratio just for the non-modeled cat exposure.

→ For instance, assume we used the non-mo ed cat loss pure premium for a homeowners' book of business. Using the amount of insurance years (AIY), which is the total amount of insurance for all policies inforce during the calendar year, the process for determining the pure premium is:

1) Calculate the ratio of non-modeled cat losses to AIY for each year in the experience
2) Average the cat-to-AIY ratio for all years
3) Apply the non-modeled cat provision per AIY to the average AIY per exposure expected in the future to get the non-modeled cat pure premium

→ Problem solving

→ In general: $\frac{\text{cat loss}}{\text{AIY}} \times \frac{\text{AIY}}{\text{Exposures}} = \frac{\text{Cat loss}}{\text{Exposures}} = \text{Cat PP}$

$\approx \frac{\text{claim count}}{\text{Exposure}} \times \frac{\text{losses}}{\text{claim count}} = \frac{\text{losses}}{\text{Exposure}} = \text{PP}$

equivalent to → freq × sev →

7.2 → Rate Benefit & Changes

7.2.1 → Examining effects of rate & benefit changes

→ Current-Rate Level Simply demonstrated

→ Recall that when using past data for ratemaking, it is important to adjust the data to what is expected in the future when rates will be in effect.

→ For instance, assume that all insurance policies during the historical period were written at a rate of $100. After the historical period, a rate increase of 10% went into effect, which means the current rate in effect is $110.

→ Now, assume the indicated rate for the future ratemaking period is $115. If the 10% rate increase that went into effect after the historical period is not considered, then the historical rate of $100 will be compared to the indicated rate of $115. This will imply the current rates should increase by 15%. However, this would cause rates to actually increase to 1.10(1.15) = 1.265, which is higher than what was indicated.

→ By first restating the historical premium to the current rate level of $110, the actual rate increase needed for an indicated rate of $115 can be calculated:

$\frac{115}{110} - 1 = 0.0455$

→ Examining impact of various changes on premium is just changes by policy. wsw!

→ For losses, restating each claim individually is the ideal method

7.2.2 → Adjusting historical premium: Extension of exposures method

→ Extension of exposures

→ The extension of exposures method entails restating each policy to restate the historical premiums as if it had been charged under the current rates. This process can be divided into two steps:

1) Treat every policy using the current rates. This means we take the rating characteristics of each policy from the historical period & recalculate the premium based on the current rates
2) Recalculate the EP for each period using this updated rates

7.2.3 → Adjusting historical premium: parallelogram method

→ Overview → Easier, but less accurate than extension of exposures method

→ Assumes: 1) policies are written uniformly over time & 2) typically applied at an aggregate level using a series of overall avg rate changes

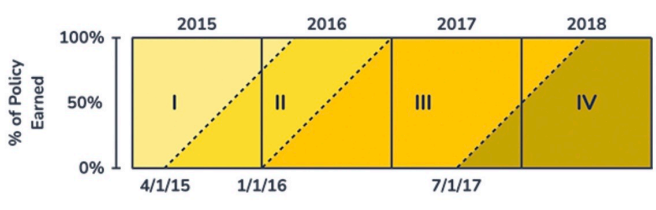
→ parallelogram method standard calculations

→ To summarize, the parallelogram method requires the following steps:

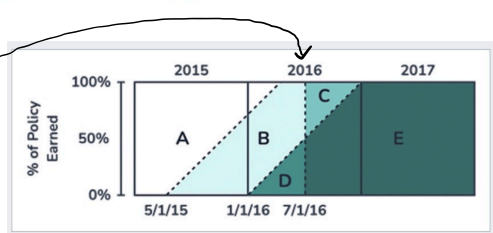
1) Determine the timing & amount of the rate changes
2) For each rate level group, calculate the cumulative rate level index
3) For each time period, calculate the portion of premium that corresponds to each rate level group
4) For each time period, calculate the weighted average cumulative rate level index
5) For each time period, calculate the on-level factor as the ratio of the current cumulative rate level index & the average cumulative rate level index for the appropriate year

$\text{on-level factor} = \frac{\text{Current Cumulative Rate level index}}{\text{Avg Rate level index for historical period}}$

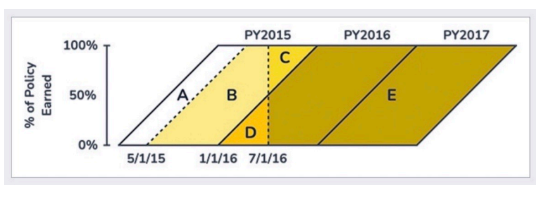
6) Apply the on-level factor to the EP for the relative time period



→ Rate changes mandated by law



→ Policy Year



→ On-levelling UP

→ So far, we've covered how to on-level EP. When on-levelling UP for policy years, the approach will be the same as on-levelling EP since EP is equal to UP. However when on-levelling UP for calendar years, the approach will be slightly different.

→ Rate changes initiated by a company will apply to policies that go into effect on or after the effective date of the rate change. Since UP is written as long as the policy is written, these rate changes can be depicted by a vertical line in the diagram.

→ On the other hand, rate changes mandated by law will apply proportionally to all policies that are inforce as of the effective date. For instance, for annual policies, a rate increase mandated by law will require additional premium from all policies written in the year leading up to the effective date. So, these rate changes can be depicted by a diagonal line that starts one year before the effective date & ends at the effective date.

→ The important thing to note is that the initial UP will apply to the CY in which the policy was written, but the additional (or reduction in) UP caused by a rate increase (or decrease) mandated by law will apply to the CY in which the rate change took effect. So, to avoid attributing additional UP to an incorrect CY, it helps to draw the diagram for one CY at a time. To see how this works, consider the example below.

7.2.4 → Adjusting historical losses

→ (pretty much same as parallelogram method for premium)

→ final adjustment factor = $\frac{\text{Current loss level}}{\text{Avg loss level of historical period}}$

7.3 → Development

7.3.1 → Development triangles

→ Example →

Accident Year	Cumulative Paid Claims by Age ($US Millions)			
	12 Months	24 Months	36 Months	48 Months
2019	102	135	161	160
2020	100	121	152	
2021	108	150		
2022	110			

Accident Year	Valuation Dates by Age			
	12 Months	24 Months	36 Months	48 Months
2019	12/31/19	12/31/20	12/31/21	12/31/22
2020	12/31/20	12/31/21	12/31/22	
2021	12/31/21	12/31/22		
2022	12/31/22			

★ pay attention to what's given

→ There are several different development triangles of ratios & average values that can be used for diagnostics. Some common examples & what they can be used for include (these are just examples, don't need to memorize)

→ Paid losses divided by reported losses → this can show if there is a speedup or slowdown in closing claims over time. It can also show changes in case reserve adequacy

→ Total closed claim counts divided by reported claim counts → This can show if there is a speed up or slowdown in closing claims over time.

→ Claim counts on closed w/ payment divided by total closed claim counts → This can show if a higher or lower percentage of claims are being closed w/ pay.

→ Claim counts on closed w/o payment divided by total closed claim counts → — — — — — — — — — — — — — — w/o pay.

→ Average case reserves (case reserves divided by outstanding claim counts) → This can show severity trends, if there is a speedup or slowdown in closing small claims relative to large claims, or changes in case reserve adequacy

→ Average paid on closed claims (cumulative paid losses on closed claims divided by claim counts closed w/ payment) → this can show if there is a speedup or slowdown in closing small claims relative to larger claims. It can also show severity trends

→ Average reported (reported losses divided by reported claim counts) → This can show changes in case reserve adequacy.

7.3.2 → Developing premiums

→ Key need to develop premiums for when 1) an incomplete year of data is used or 2) LOB w/ audits

7.3.3 → Developing losses

→ Summary → Chain ladder method (development technique) steps

1) Compile Claims data
2) Calculate age-to-age factors
3) Calculate averages
4) Select claim development factors
5) Select tail factor
6) Calculate cumulative claim development factors
7) Project ultimate claims

a) straight average
b) medial average (Olympic) → 1, 2, 3, 4 = $\frac{2+3}{2} = 2.5$)
c) geometric average → nth root of product
d) volume-weighted → remember to have same # of #s on num & denom

Ideas to keep in mind when selecting: smooth progression, stability, credibility of experience, change in patterns, applicability of the historical period, shock losses / cat losses

⇒ Note on selecting factors

> You can select anything that seems reasonable, whether that's an average, a particular age-to-age factor, or anything else. Use your actuarial judgement when selecting factors. And remember, you don't have to make the same type of selection at each maturity either. If the age-to-age factors look unstable at 12 months but fairly stable for other maturities, it might be reasonable to select the medial average at 12 months and the straight average for other maturities.
>
> On the exam in general, there are no strict rules for what factor to select as long as you make a reasonable choice. The default selection would be the straight average, but if there's a reason to not do that, make a different selection and explain your reasoning for doing so.

7.4 → Trending

7.4.1 → Actuarial standard of practice No. 13

→ ★ read this before exam

→ Definitions →

- *Experience period*: the time period in which the historical data occurs.
- *Forecast period*: the future time period to which historical data is projected.
- *Social influences*: the impact on insurance costs of changes in claim consciousness, court practices, legal precedents, and other non-economic factors.
- *Trending period*: the time over which the trend is applied when projecting from the experience period to the forecast period.
- *Trending procedure*: a process that involves estimating future values by analyzing changes between exposure periods that can impact claim costs and frequencies, exposures, premiums, expenses, retention rates, marketing/solicitation response rates, and economic indices.

7.4.2 → Selecting data for trending

→ Exposure data → Some LOBs rely on exposure measures, such as payroll or sales revenue, which can be influenced by time-related factors like inflation. May need to account for this w/ exposure trends

→ Premium data → The average premium level can change over time due to inflationary pressure as well. Another type of change over time to the premium level is a distributional change, which is a change in the characteristics of the policies written. The resulting change in the premium level is known as premium trend.

→ e.g. policy characteristic such as amount of insurance for a homeowners policy increases w/ inflation ⇒ avg premium increases

shift in deductibles at renewal causes premium shift (e.g. $5k)

→ Loss data → Changes over time in the expected levels of claim frequency & severity are known as loss trends. Loss trends can be driven by many different factors, such as: inflation, increasing medical costs, advancements in safety tech, demographic changes (like a growing population of risky policies)

→ Can be estimated by analyzing pure premium directly or freq/sev separately (as they may have different drivers)

→ order of operations → Trending is typically performed after adjusting the data for anomalies like catastrophes & rate or benefit changes, ensuring any distortions in the true trend are eliminated.

→ Additionally, trending can be applied either before or after the data is developed to ultimate values