

## 2.1 → Rate-making principles, considerations, & adjustments

### 2.1.0 → Overview & 2.1.1 → Rate-making principles & considerations

→ Rate-making is the process of determining the premium so that the fundamental insurance equation is balanced.

$$\text{Premium} = \text{Losses} + \text{LAE} + \text{var Expenses} + \text{var Profit}$$

→ Rate-making principles or 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 losses (is below at expense level)

→ Principle 2 → A rate provides for all costs associated with the transfer of risk (is below at expense level)

→ Principle 3 → A rate provides for the costs associated with an individual risk transfer (is below at individual level)

→ Principle 4 → A rate is reasonable & not excessive, homogeneous, & uniformly discriminatory if it is an actuarially sound estimate of the expected values of all future risks associated with an individual risk transfer

→ Rate-making considerations → Tries to take into account when developing rate-making methodologies

→ Exposure underwriting organization or data, influences on data, adjustments to data, homogeneity, credibility, classification plans, individual risk ratings, actuarial judgement

→ Influences on data → Five things to be considered

→ Policy provisions, risk & claims, operational changes, other influences

→ Evaluating & adjusting rate-making data → Adjustments to make to ensure the data reflects anticipated future losses accurately

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

### 2.1.2 → Shock losses

→ Determining historical losses need several adjustments before they can be used for rate-making, including:

→ Reflecting extraordinary events in the historical data set long-term experience

→ Adjusting losses for changes in coverage or benefits, including changes required by law

→ Declining insurance losses to their ultimate settlement value

→ Trending losses to reduce the benefit & cost trends occurring 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 prior adjustments are made.

→ For instance, if the long-term experience for reinsurance losses has already been trended to the period the rates will be in effect, that experience should not be added to historical losses until those losses have also trended to the same period.

→ Principles based on occurrences vs. claims losses

→ If no shock losses occur, prices will be an underestimation of losses compared to the fair price when shock losses are considered  $\Rightarrow$  indicated rate

→ If shock losses occur, prices will be an overestimation of losses  $\Rightarrow$  indicated rate

$\downarrow$  Same for CATS

→ Adjusting for shock losses (Steps)

→ 1) Operations include → Building shock losses initially

→ Long-run losses based on the maximum amount of insurance offered, typically referred to as the basic limit, or the limit associated with the base rate

→ Long-run losses as a distance from 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.

→ 2) Indirect provision → First need to consider two conflicting goals though when determining the threshold

→ i) Include as many losses as possible

→ ii) minimize volatility on the rate-making analysis

→ 3) Indirect provision

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→ Determining shock loss provision

→ For 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) Calculate the ratio of excess losses to non-excess losses

4) Calculate the excess loss loading factor as 3 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.

$\rightarrow$  In general:  $\text{Ratio} = \frac{\text{Excess Losses}}{\text{Non-Excess Losses}}$

$\text{Ratio} = \frac{1}{3} \times \text{Ratio}$

$\text{Yearly ad. Losses} = \text{Ratio} \times \text{Losses} \times \text{Factor}$

### 2.1.3 → Catastrophe data

→ Adjusting for catastrophes

→ To adjust for catastrophes when projecting future losses for reinsurance, 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:

i) non-modified cat losses

ii) modified cat losses

→ Non-modified cat analysis is used for events that occur somewhat regularly over a period of many years, like heat storms.

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

→ Not events, but it often need to use  $\Rightarrow$  total cat provision = non-modified cat Pmt Premium + modified cat loss Pmt Premium

→ Determining non-modified cat loss provision

→ Method 1: cat loss loading factor

→ One method for setting the recommended cat loss provision is to follow the same process used for the shock loss provision.

i) Sum the cat losses

ii) Sum the non-cat losses

iii) Calculate the ratio of cat losses to non-cat losses

iv) Calculate the cat loss loading factor as 3 plus the ratio found above

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

→ Method 2: cat loss pure premium

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

→ For instance, assume we used the mean cat cat loss premium for a homeowners' book of business. Using the amounts on insurance years (AY), which is the total amount of insurance for all policies written during the calendar year, the formula for determining the pure premium is:

i) Calculate the ratio of non-modified cat losses to AY for each year in the experience

ii) Average the non-modified cat losses for all years

iii) Apply the non-modified cat provision per AY to the average AY per exposure expected in the future to get the non-modified cat pure premium

$\rightarrow$  In general:  $\text{Cat Loss AY} = \frac{\text{Cat Loss}}{\text{AY}} \times \frac{\text{AY}}{\text{Exposure}} \times \frac{\text{Exposure}}{\text{Cat Loss}} = \text{Cat Pmt}$

$\Rightarrow$  Cat Loss AY =  $\frac{\text{Cat Loss}}{\text{Cat Loss}}$

similar to  $\frac{\text{Cat Loss}}{\text{Cat Loss}} \times \text{Cat Loss} = \text{Cat Pmt}$

$\rightarrow$  Appropriate to use a larger loss loading factor when there has been a large loss, due to

$\Rightarrow$  Cat Loss AY =  $\frac{\text{Cat Loss}}{\text{Cat Loss}} \times \text{Cat Loss} \times \text{Factor} \rightarrow$  the higher the cat excess loss, the greater the relative to the historical non-excess loss (if given)

### 2.1.4 → Reinsurance

→ Types → Proportional (i.e. quota-share, etc.  $\frac{\text{X}}{100}$ )

Inclusive reinsurance analysis?  $\rightarrow$  yes (is reduce basis & premium proportionally  $\frac{\text{X}}{100}$ )  
Inclusive non-reinsurance as an excess item

→ non-proportional → excess-cat-loss

$\Rightarrow$  % effects cat loss ratio

### 2.2 → Rate Benefits & Changes

2.2.1 → Examining effects of rate & benefit changes

→ Effects of changes

→ Direct effects are direct & obvious impacts on premium or losses resulting from changes in rates or benefits. Examples include:

i) ↑ rates  $\Rightarrow$  ↑ premium

ii) ↓ policy limit  $\Rightarrow$  ↓ losses

iii) excluding certain coverages  $\Rightarrow$  ↓ losses

→ Indirect effects are less straightforward

→ Measuring effects → Examining impact of various changes on premium or net charge by policy year!

→ for losses, reducing each claim individually or the ideal method

→ Current - Rate Level Simple demonstration

→ Point out when using past data for rate-making, it is important to adjust the data to what is expected in the future when rates will be in effect.

→ For instance, assume all insurance written during the historical period was written on a rate of 10%. After the historical period, a rate increase of 10% went into effect, which means the current rate is now 11%.

→ Now, assume the indicated rate for the future rate-making period is 10%. For the last rate increase that went into effect after the historical period is not evident, then the historical rate of 10% will be compared to the indicated rate of 10%. This will imply the current rate should increase by 10% again. However, this would cause the actual rate to increase to 11%, which is higher than what was indicated.

→ By first reducing the historical premium to the current rate level of 10%, the actual rate increase will be an indicated rate of 11% (e.g.  $\frac{11}{10} = 1.10$ )

### 2.2.2 → Adjusting historical premium: Estimation of changes needed

→ Estimation of exposures

→ The estimation of exposures involved re-rating each policy to reflect the historical premium as if it had been charged under the current rates. This process can be divided into two steps:

i) Make every policy using the current rates. This means we take the rating characteristics of each policy from the historical period & re-rate the premium based on the current rates.

ii) Calculate the EP for each policy using the updated rates

→ Challenges → Increasing historical data may not always be available

→ Inclusive estimates

→ Assumptions are made for new rating variables when no data is available

### 2.2.3 → Adjusting historical premium: Parallelogram method & 2.2.4 → Adjusting historical losses

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

→ Assumption: 12 policies are written uniformly over time & 3 typically applied at an aggregate level using a simple overall rate rate changes

$\rightarrow$  to get annual Pmt, without exception can use another time

rating, such as quarters

→ Parallelogram method: standard calculation

→ To demonstrate, the parallelogram method requires following steps:

i) Determine the timing & amount of the rate changes

ii) Formulate rate level group, calculate the cumulative rate level index

iii) For each time period, calculate the portion of premium that corresponds to each rate level prior

iv) For each time period, calculate the unlevel factor as the ratio of the current cumulative rate level index to the average cumulative rate level index for the respective year

unlevel factor =  $\frac{\text{Current Cumulative Rate Level Index}}{\text{Avg Rate Level Index for Historical Period}}$

v) Apply the unlevel factor to the EP for the relative time period

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→ for losses, reducing each claim individually or the ideal method

→ same steps for PYs

(same for losses too)

### 2.3 → Development

2.3.1 → Development factors

→ List of items a company might have in the various departments are an answer

→ Claims → Addressing case guidelines, changes in reserves, credibility, case load, claims, the process of establishing a claim file, reported claims, etc.

→ Underwriting → Insuring more changes in terms of composition, underwriting guidelines, large risks, self-insured coverage, program tracking