

### 1.3 → The fundamental insurance equation

#### 1.1.1 → Basic insurance terms

→ Relationship between  $LPF \rightarrow EP$

→  $LPF > EP \Rightarrow$  high growth

→  $LPF < EP \Rightarrow$  shrinking

→ Insured (reported) loss = Actual loss + Loss reserve

→ Estimated ultimate loss = Insured loss + Loss reserve + Losses reserve

→  $LAE = ALUL - ULAL$

→ Underwriting profit = Income - Expenses (from writing business on policies)

#### 1.1.2 → The fundamental insurance equation

→  $POL = LIP + Profit$

↓  
Premium ↓ Loss, LAE, ULAL

→ Total profit = Underwriting profit + Investment income

#### 1.1.3 → Basic insurance ratios

→ Frequency =  $\frac{\# \text{ claims}}{\# \text{ exposures}} \rightarrow$  <sup>Typically</sup> reported claims

↓  
→ covered exposures

→ Severity =  $\frac{\text{Losses}}{\# \text{ claims}}$ , Variations  $\rightarrow$  Paid severity =  $\frac{\text{Losses on paid claims}}{\# \text{ paid claims}}$

↑  
→ premium may include  $\rightarrow$  reported severity =  $\frac{\text{Reported losses}}{\# \text{ reported claims}}$   
or actual losses

→ Pure premium (or loss ratio) =  $\frac{\text{Losses}}{\text{Exposures}}$   
 $= \frac{\# \text{ claims}}{\# \text{ exposures}} \times \frac{\text{Losses}}{\# \text{ claims}}$   
 $= \frac{\# \text{ claims}}{\# \text{ exposures}} \times \frac{\# \text{ losses}}{\# \text{ claims}}$   
 $= \text{Frequency} \times \text{Severity}$

→ Average premium =  $\frac{\text{Premium}}{\text{Exposures}}$  ( $\rightarrow$  both ended or still written)

→ Loss ratio =  $\frac{\text{Losses}}{\text{Premium}}$   
 $= \frac{\# \text{ losses}}{\# \text{ exposures}}$   
 $= \frac{\text{Losses} / \# \text{ exposures}}{\text{Premium} / \# \text{ exposures}}$   
 $= \frac{\text{Pure premium}}{\text{Avg. Premium}}$

→ Loss + LAE ratio =  $\frac{\text{Loss} + \text{LAE}}{\text{Premium}}$

→ LAE ratio =  $\frac{\text{LAE}}{\text{Loss}}$

→ Loss Ratio ( $1 + \text{LAE ratio}$ ) =  $\frac{\text{Loss}}{\text{Premium}} (1 + \text{LAE ratio})$   
 $= \frac{\text{Loss} + \text{LAE}}{\text{Loss}}$   
 $= \frac{\text{Loss} + \text{LAE}}{\text{Premium}}$   
 $= \text{Loss} + \text{LAE ratio}$

→ UW expense ratio =  $\frac{\text{UW expenses}}{\text{Premium}}$   $\rightarrow$  <sup>①</sup> incurred or incurred  $\rightarrow$  during policy term  $\rightarrow$  <sup>②</sup>

→ UW expense ratio =  $\frac{\text{UW expenses}, \text{other adjustments, Paid, Unpaid others}}{\text{WP}}$   $\rightarrow$  <sup>①</sup>  $\rightarrow$  <sup>②</sup> general carriers

→ Operating expense ratio (OER) = UW expense ratio  $\rightarrow \frac{\text{LAE}}{\text{EP}}$   
 $\rightarrow$  measures portion of each premium dollar used towards paying claim related expenses of UW expenses

→ Combined ratio =  $\frac{\text{Losses}}{\text{EP}} + \frac{\text{LAE}}{\text{EP}} + \frac{\text{UW expenses}}{\text{WP}}$   $\rightarrow$  breakdown to 100%

↓  
 $= \text{Loss ratio} + \text{LAE ratio} + \frac{\text{UW expenses}}{\text{WP}}$   $\rightarrow$  breakdown to 100%  
 $= \text{Loss ratio} + \text{OER}$   $\rightarrow$  if UW expenses are measured during the policy term  
 $\rightarrow \div \text{by EP instead of WP}$

→ Close ratio =  $\frac{\text{UW accepted quotes}}{\text{UW quotes}}$

#### 1.2 → Policies, exposures or claims

##### 1.2.2 → Exposures

→ Exposure = a basic unit that measures a policy's exposure to loss. It is the basis for the calculation of premium.

→ Criteria for exposure basis

→ 1) proportional to exposure loss  $\rightarrow$  the factor that is most directly proportional to losses (ie. loss increase or decrease  $\Rightarrow$  loss increase or decrease)

→ 2) practices  $\rightarrow$  objective, easy/inexpensive to obtain a verifiable

→ 3) historical precedents  $\rightarrow$  should consider any prevailing exposure base established in the industry. Changes need to be carefully considered

#### 1.2.3 → Understanding insurance data

##### 1.2.3.1 → Aggregating data

→ Four methods of data aggregation:

→ Calendar year aggregation

→ Calendar year aggregation groups data according to the calendar year. For example, CY 2020 earned premiums are all exposures earned between Jan 1, 2020 & Dec 31, 2020, regardless of when the policies were issued. Similarly, CY paid losses include all losses paid during the accident date or report date CY, regardless the 12-month

→ Advantages  $\rightarrow$  data is readily available once the CY ends

→ True  $\rightarrow$  no future development, as the values for premium, exposures + losses are fixed at the end of the CY

→ Data is easily accessible at no additional cost, as most insurers conduct financial reporting on a CY basis

→ Disadvantages  $\rightarrow$  mismatch between premium & losses

→ Premium earned during the CY comes from policies in force during the CY, which could have been written in the previous CY or to current CY

→ Losses may include payments + reserve changes on claims from policies issued a year ago

→ Inability to capture major developments due to the fixed nature of data

→ CY aggregation is well suited for lines of business or coverages where the losses are reported + settled relatively quickly such as homeowners insurance.

→ Accident year aggregation

→ Accident year aggregation of losses groups losses according to the accident date. For example, for 2020 reported losses include loss payments & case reserves for claims that occurred in 2020 regardless of the policy issuance date or the report date. Losses can be added & change over the accident year ended due to additional claim reports, loss payments, + reserve changes.

→ At a aggregation of premium & exposures is nearly the same as CY premium & exposures. Thus, this method is often referred to as calendar-accident year or fixed-accident year.

→ The one exception to this is for lines of business that require premium audit. CY aggregation allows an auditor to be audited after the end of the policy period, whereas CY aggregation typically doesn't.

→ Advantages  $\rightarrow$  Easy to adjust or easy to understand

→ Better match of premiums & losses than CY aggregation, as losses paid for claims that occurred during the year are compared to premium earned during the same year

→ Used for identifying the impact of major claim events (eg. catastrophe) or changes due to elements of regulatory forces (eg. inflation or law amendments) on claim exposure

→ Disadvantages  $\rightarrow$  requires adjustment of future development to known losses that are not clear at the end of the year

→ provides a less accurate matching of premiums & losses

→ Policy year aggregation

→ Policy year aggregation, aka underwriting year aggregation, groups data according to the year in which the policies were written.

Policy year earned premium & exposures include all premium & exposures earned from policies written during the year, regardless of when they were reported or paid. Premium & exposures are not fixed until all the policies written during the year have expired. Losses can be added & change over the policy year due to additional claims reports, loss payments, + reserve changes.

→ Advantages  $\rightarrow$  easier to adjust or simpler to understand

→ Capital for underwriting the year is more stable than CY aggregation, as the CY of losses is fixed at the end of the year

→ Disadvantage  $\rightarrow$  requires adjustment of future development to known losses that are not clear at the end of the year

→ Provides a less accurate matching of premiums & losses

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