Ratemaking

Stat 346 - Short-term Actuarial Math

Example 4.3 from book

Calculate the indicated average rate given the following information.

- Expected effective losses - 30,000,000
- Earned Exposure Units - 1,000,000
- Earned Premium at current rates - 45,000,000
- Current average rate - 45
- Fixed Expenses - 5,000,000
- Fixed expenses per exposure unit - 5
- Premissable Loss Ratio - 0.75

Example 4.3 from book

Loss Cost method

$$\text{Expected Effective Loss Cost} = \frac{30,000,000}{1,000,000} = 30$$

$$\text{New rate} = \frac{30+5}{0.75} = 46.67$$

Loss ratio method

$$\text{Expected Effective loss ratio} = \frac{30,000,000}{45,000,000} = 0.66$$

$$\text{Fixed Expense Ratio} = \frac{5}{45} = 0.1111$$

$$\text{Indicated rate change} = \frac{0.666+0.111}{0.75} = 1.037037$$

So the new rate would be the current rate times the rate change,

$$\text{New Rate} = 45(1.037) = 46.67$$

Example

Full Loss Cost problem. You know that reported claims for the last few year follow this claims triangle.

Claims Triangle			
Accident Year	**DY0**	**DY1**	**DY2**
2022	$150,000$	$200,000$	$250,000$
2023	$180,000$	$220,000$	
2024	$200,000$		

- The permissible loss ratio is 75%.
- The trend factor for exponential claims growth is $\delta = 0.075$.
- The first two loss development factors for losses is estimated to be 1.27 and 1.25.
- There are 1,000 exposure units and fixed expenses per exposure is \$30.
- Assume no additional losses from years prior to 2022 and no tail factor

What should the rate be based on the loss cost method for a new one year policy starting in 2025? Use a weighted average of 70% 2024 losses and 30% 2023 losses.

Example

First off, losses must be developed. We'll divide by the exposure unit of 1,000 right off.

- **2022**: 250
- **2023**: $220(1.25) = 275$ per exposure
- **2024**: $200(1.27)(1.25) = 317.5$ per exposure

We need to trend this for 2025 policies. Projected losses from 2024 are

$$317.5 \times \exp\left(.075(1.5)\right) = 355.30$$

The time period is 1.5 using parallelograms. Projected losses for 2023 are

$$279.4 \times \exp\left(.075(2.5)\right) = 337.02$$

. We will use losses of $.7(355.30) + .3(337.02) = 349.82$. Then the rate is

$$(349.82 + 30)/.75 = 506.43$$

Example

Full Loss Ratio problem. Let's borrow the information we got from the last problem.

- Expected effective losses are \$349.82 per exposure unit
- Fixed expenses per exposure are \$30.
- PLR is 0.75

In 2022 there was \$460 of earned exposure. We want to convert this to rates as of January 1st, 2025. There was a 5% rate increase on April 1st, 2022 and a 6% rate change on November 1, 2023. What are 2022 earned exposure as of January 1st, 2025? Once you find it, use that to find the rate change for 2025.

Example

Total rate change to 2025 is $(1.05)(1.06) = 1.113$. The rate level for 2022 using parallelogram is $(0.7185 \times 1) + (0.2815 \times 1.05) = 1.014$. The on level factor then is $\frac{1.113}{1.014} = 1.0976$. So earned premiums per exposure is $460 \times 1.0976 = 504.87$.

Now we have that we can find expected effective loss ratio is $349.82/504.87 = 0.693$. The fixed expense ratio is $30/504.87 = 0.0594$. Then the indicated rate change is

$$\frac{0.693 + 0.0594}{0.75} = 1.003$$

This says rates should increase by 0.3%. If the current rates were \$500 then the new rates would be $(500)(1.003) = 501.53$.