Notation	Term
R	Reserve
$L^{ m ult.}$	Ultimate Losses
L^P	Losses Paid-to-date
P^E	Earned Premium
ELR	Expected Loss Ratio
f	Age-to-Age Factor
$oldsymbol{t}$	Age of Claims at Valuation
i	Index for Accident Year
\boldsymbol{k}	Index for Development Year

Expected Loss Ratio Method

1. Estimate the ultimate losses by multiplying the earned premium by the expected loss ratio.

$$\hat{L}^{ ext{ult.}} = P^E imes ELR$$

2. Subtract the losses paid-to-date to estimate reserves.

$$R=\hat{L}^{ ext{ult.}}-L^{P}$$

Chain-Ladder Method

This is also known as the **Loss Development Method** or the **Loss Triangle Method**.

1. Calculate and select the age-to-age factors.

$$f_{i,\,k}=rac{L_{i,\,k}}{L_{i,\,k-1}}$$

$$f_i^{ ext{ult.}} = \prod_{k=t+1}^\infty f_k$$

2. Estimate the ultimate losses by multiplying the losses paid-to-date by the age-to-ultimate factors.

$$\hat{L}_i^{ ext{ult.}} = L_{i,\,t} \cdot f_i^{ ext{ult.}}$$

3. Subtract the losses paid-to-date to estimate reserves.

$$R_i = \hat{L}_i^{ ext{ult.}} - L_i^P$$

Bornhuetter-Ferguson Method

Calculate reserves as:

$$R_{BF} = \hat{L}_{LR}^{ ext{ult.}} \left(1 - rac{1}{f_{CL}^{ ext{ult.}}}
ight)$$

where

• the paid loss age-to-ultimate factor is based on the chain-ladder method:

$$f_{CL}^{ ext{ult.}} = \prod_{k=t+1}^{\infty} f_k$$

• the ultimate loss is based on the expected loss ratio method:

$$\hat{L}_{LR}^{ ext{ult.}} = P^E imes ELR$$

Note: The Bornhuetter-Ferguson estimate of the ultimate losses is $\hat{L}_{BF}^{ ext{ult.}} = L^P + R_{BF}.$

Alternatively, we can also calculate reserves as:

$$R_{BF} = w \cdot R_{CL} + (1-w) \cdot R_{LR}$$

where
$$w=rac{1}{f^{
m ult.}}$$
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