

Pension

Gain By Source

$$Pr_k = ({}_{k-1}V + G_{k-1} - e_{k-1})(1 + i) - q_{x+k-1}^{(d)}(b_k + E_k^{(d)}) - q_{x+k-1}^{(w)}(CV_k + E_k^{(w)}) - p_{x+k-1}^{(\tau)} {}_kV$$

- Pr_k : profit in year k per policy in force at the beginning of year k.
- G_{k-1} : gross premium for year k (subscript k-1 indicates time of payment)
- e_{k-1} : annual expenses for year k (subscript k-1 indicates time of payment)
- i : the profit test interest rate
- b_k : death benefit for death in year k
- $E_k^{(d)}$: expenses for settling death claims in year k
- CV_k : cash surrender value in year k
- $E_k^{(w)}$: expenses for handling surrenders in year k

1. Expected profit: the profit computed using the interest, mortality, surrender, and expense rates assumed in pricing the product; in other words, the assumptions used in computing the premium.
2. Actual profit: is computed using actual experience for interest, mortality, surrender, and expense.
3. Gross premium reserve recursion formula if surrenders are considered is:

$${}_kV = \frac{({}_{k-1}V + G_{k-1} - e_{k-1})(1 + i) - q_{x+k-1}^{(d)}(b_k + E_k^{(d)}) - q_{x+k-1}^{(w)}(CV_k + E_k^{(w)})}{p_{x+k-1}^{(\tau)}}$$

4. Gain: if experience does not equal assumptions, the difference between actual profit and expected profit. Gain can be broken down into interest, mortality, surrender, and expense components.
5. Gain By Source analysis:
 - a. At the beginning of the year, before the premium is paid, assets = reserve. To the extent they are different, this represents a gain from a previous year, which was accounted for in that year.
 - b. Calculate the difference in interest rates times the starting assets plus beginning-of-year cash flows. (The difference in interest rates is multiplied by the sum of the previous year's ending reserve and premium, minus beginning-of-year expenses. Mortality and expense are as assumed).
 - c. Calculate the expense difference, the excess of assumed over actual expenses, both for beginning-of-year and settlement expenses. (Use actual interest but assumed mortality).
 - d. Calculate the mortality difference, the excess of assumed over actual mortality, times the net amount at risk plus settlement expenses. The net amount at risk is the face amount minus the end-of-year reserve. (Use actual interest and expenses).
 - e. Calculate the surrender difference, the excess of assumed over actual surrender, times the cash value plus settlement expense minus the end-of-year reserve.
- Components of gain: in each component, primed are actual, starred are assumed.
 - o Interest: $(i' - i^*)({}_{k-1}V + G_k - e_k)$
 - o Expenses: $(e_k^* - e_k')(1 + i) + q_{x+k-1}(E_k^* - E_k')$
 - o Mortality: $(q_{x+k-1}^* - q_{x+k-1}') (b_k + E_k - {}_kV)$
 - o Lapse: $(q_{x+k-1}^{(w)*} - q_{x+k-1}^{(w)'}) ({}_kCV + E_k^{(w)} - {}_kV)$