

UNDERWRITING AND EXTRA RISKS IN LIFE INSURANCE

Katarína Sakálová

1. The process of underwriting

Underwriting is the process by which a life insurance company decides which people to accept for insurance and on what terms. Life insurance company insures three types of risks: investment, mortality and morbidity risk and want to place a price on each risk it insures. In praxes insurer charges the same risk premium for group of individuals. Then the main idea is that the risk premium covers the average risk in this group. But if the premium is not adequate to the average risk in this group, then the company will probably make a loss.

To prevent this life insurer separates the homogenous individuals who want insurance into homogenous groups with respect to the main factors that affects the mortality and morbidity risk. This separation into homogenous groups is the **selection** process. The introduction of selection does not lead to an improvement of overall mortality experience, but the experience will be better for the select group (for smaller premiums) and correspondingly worse for the non-select group (for greater premiums).

Insurers exercise selection but potential policyholders try to exercise **anti-selection**. Anti-selection is an attempt of policyholder to take out a contract on terms that are better than he or she should get.

The process of underwriting has three stages:

1. The first stage is the class selection. Company decides to whom and how it wills sales its products.
2. The second stage begins when the insurer receives a proposal form. On this information is based the company's decision between these possibilities:
 - accept the proposal on the standards premium of insurer,
 - accept the proposal on special terms,
 - postpone further consideration of the proposal,
 - reject the proposal.
3. When underwriter accepts the proposal on special terms then considers the nature of the risk and translates this into the special terms.

Underwriting covers the selection process, the determination of the terms to offer to lives who are not in the select group and reduces effects on a insurers experience that arise from the anti-selection.

2. Sources of information

Proposal form. Every potential policyowner need to complete a proposal form. It will contain two group of information: First - details relating to the contract that an applicant wants to buy and the name, address, age and the sex of the applicant. Second – details of the applicant's medical and financial history (marital status, height, and weight, smoking and drinking habits,...).

Personal medical report. When the applicant has a personal medical attendant, the underwriter may obtain a report on the applicant's medical history.

Specific condition questionnaire, Medical examination, Specialist medical report. Insurer needs these four sources of information if it suggests other medical evidence or if the cover is very high.

Financial questionnaire. Insurer needs this source of information if the cover is very high.

3. Extra risks

An extra risk arises where a proposal for life insurance is not acceptable at standard rates. The amount of extra risk then represents the underwriter's assessment of how much worse the applicant is in mortality or morbidity terms than a standard risk.

A life insurer has to achieve a balance between having competitive premium rates and having a generous underwriting policy. It is found in practice that most insurers follow generally similar underwriting policies and accept at normal rates between 90 % and 95 % of the proposals made to them.

Extra risks fall into the following four categories:

- a) **Health risks:** These constitute the majority of extra risks encountered and cover all extra risks that arise for a medical reason of any kind.
- b) **Occupational risks:** Certain jobs give rise to an increased risk of death, injury or illness.
- c) **Recreational risks:** This category contains for example activities as hazardous sports (private flying, motor racing, hang-gliding).
- d) **Foreign residence:** Companies usually use the notion foreign to mean outside Europe, North America and Australia and residence other than for holiday.

Every extra risk may be characterised by its intensity and its incidence. The intensity for mortality risks may be expressed in three basic ways:

- **percentage of normal mortality**
This is the most common method employed. In practice the percentage applies to q_x or μ_x . The minimum level of extra risk would be + 25 %.
- **addition to the age**
In the past, but less commonly now, the degree of extra risk was specified as a fixed addition of for example five years to the age of the life to be assured. So if the applicant aged x is subject to an extra risk is for company equivalent that applicant is a standard life aged $(x + 5)$.
- **addition to the rate of mortality**
The intensity of the extra risk may be described as a fixed addition to the normal rates of mortality. For example if μ_x is the force of mortality from the standard table the extra risk has a force of mortality at age x of μ_{x+c} .

After this insurer can convert quantified extra risk into the special terms. The special terms will take one of the two basic forms – extra premium and debt.

4. Extra premiums

An extra premium is an additional premium that the life insurance company charges on the top of its standard premium where an applicant is subject to an extra risk. Determination of extra premium depends on how the company has expressed the extra risk. If the company uses **percentage of normal mortality**

$$q' = \left(1 + \frac{e}{100}\right) q$$

where e is percentage of the standard mortality (which expresses additional mortality), then extra premium is e % of standard premium. This is appropriate for example for term assurance. For some types of contract (endowment and whole life assurances) is better to calculate a special premium based on q'_x . Then the extra premium is the special premium less the standard premium.

If the company has expressed the extra risk as **an increase of m years in age**, then the extra premium will be the standard premium for age $(x + m)$ less the standard premium for age x , where x is the age of the applicant. This method is easier to apply as the previous method.

When we are modelling extra risk with a **constant addition to the force of mortality** so that the force of mortality is $\mu'_x = \mu_x + c$. At this case we can model the extra mortality by increasing the rate of interest. We know that

$${}_n p_x = e^{-\int_0^n \mu_{x+t} dt}$$

Where interest rate $i = e^\delta - 1$ ($v = e^{-\delta}$) and δ is intensity of interest. Then

$${}_n p'_x = e^{-\int_0^n \mu_{x+t} + c dt} = e^{-\int_0^n \mu_{x+t} dt} e^{-cn} = {}_n p_x e^{-cn}.$$

and

$${}_n p'_x \cdot v^n = {}_n p_x \cdot e^{-cn} \cdot e^{-\delta n},$$

where $\delta = \ln(1 + i)$. From this we have

$${}_n p'_x \cdot v^n = {}_n p_x \cdot e^{-(c+\delta)n} = {}_n p_x \cdot (v')^n,$$

where $(v')^n = e^{-(c+\delta)n}$. The increased the rate of interest which allow us to model extra risk with the use of standard mortality tables we find from the following expression

$$e^{-(c+\delta)n} = \left(\frac{1}{1+i}\right)^n = (1+i')^{-n}.$$

After some rearrangements we obtain

$$-(c + \delta) n = -n \ln(1 + i').$$

and for i' :

$$i' = e^{c+\delta} - 1.$$

5. Debt

The main alternative method of allowing for extra mortality is to reduce the sum payable on death leaving the premiums unchanged and is called the debt. So a debt or lien is a deduction from the benefit payable under a contract (usually only on death) where a standard premium is payable. The method can operate in one of two ways:

- by a level debt throughout the period of the assurance, or for a limited period,
- by a debt which commences at a higher level but diminishes with duration either over the whole term of the assurance or over a shorter period and ultimately becomes zero.

From this definition is clear that a debt is unsuitable in the case of temporary assurance cover. In practice it is used for endowment assurance. The main argument for an office to prefer a debt rather than an extra premium is that it does not involve the policyholder in any additional payments and if a policyholder survives to such time as the debt for example becomes zero nothing will have been lost.

We try to derive the expression for debt $Z(t)$ (for the unit of a claim) at time t in the case of decreasing debt. We use the first method of quantification of extra risk. Let V_t be the reserve at the beginning of year $t+1$ and V_{t+1} the reserve at the end of year $t+1$. If P is a premium at the beginning of year $t+1$, S is the sum assured and q_{x+t} respectively p_{x+t} is the probability that the person aged $(x+t)$ does not survive respectively survive age $x+t+1$, then we have a following expression

$$(V_t + P)(1+i) = q_{x+t}(S - V_{t+1}) + V_{t+1}$$

and after some rearrangements we have

$$P(1+i) = q_{x+t}(S - V_{t+1}) + [V_{t+1} - (1+i)V_t].$$

Similar expression we have for a person with higher mortality q'_{x+t}

$$P'(1+i) = q'_{x+t}(S - V'_{t+1}) + [V'_{t+1} - (1+i)V'_t].$$

Because $p'_{x+t} + q'_{x+t} = 1$, for theoretical extra premium $P' - P$, which must pay the policyholder at the beginning of the year $(t+1)$, we have:

$$\begin{aligned} (P' - P)(1+i) &= \\ &= (q'_{x+t} - q_{x+t})(S - V_{t+1}) + [p'_{x+t}(V'_{t+1} - V_{x+t}) - (1+i)(V'_t - V_t)] \end{aligned}$$

But if the company wants to solve this situation using a debt then

$$Z(t)q'_{x+t} = (q'_{x+t} - q_{x+t})(S - V_{t+1}) + [p'_{x+t}(V'_{t+1} - V_{x+t}) - (1+i)(V'_t - V_t)].$$

If reserves for both contracts with the higher and the lower mortality are the same, then from the preceding equation we obtain

$$Z(t)q'_{x+t} = (q'_{x+t} - q_{x+t})(S - V_{t+1}).$$

If V_{t+1} is the reserve per unit of sum assured and S is the unit sum assured then $Z(t)$ is the debt for unit sum assured

$$Z(t) = \frac{q'_{x+t} - q_{x+t}}{q'_{x+t}} (1 - V_{t+1}).$$

Except for long term endowments and whole life contracts, the above formula will produce diminishing debts, since the sum at risk will usually decrease faster than any increase in the factor $\frac{q'_{x+t} - q_{x+t}}{q'_{x+t}}$.

Where the extra mortality is assessed as a constant percentage increase of the normal rates of mortality, the above equation can be simplified. Suppose $q' = \left(1 + \frac{e}{100}\right)q$, where e is the percentage of extra mortality, then the debt per unit sum assured is

$$L_t = \frac{e}{100 + e} (1 - V_{t+1}).$$

For endowment assurances it can be assumed that the sum at risk reduces in a straight line from unity at entry to zero at maturity. And so the debt is reducing linearly over the period of assurance.

6. Other methods for dealing with extra risks

Exclusion clauses. The aim of the exclusion clause is to exclude from payment of benefit deaths which arise from one or other of a number of causes which will be specified in the clause. To be effective

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