Actuarial Society of India

Examinations

November 2006

ST1 – Health and Care Insurance

Indicative Solution

[1]

(a)

Mortality: The main risk is that claimants live longer than expected, *i.e.*, claim termination probabilities are lower than expected. (A particular risk here is where treatments for specific illnesses are successful in extending life rather than curing the illness.)

There is also a risk formerly deaths of non-claimants while the asset share is negative.

Expenses: Higher than expected expenses would lead to reduce profits. Possible causes include higher than expected inflation and poor business volumes, leading to high per-policy expenses.

Investment: The investment returns on the assts backing the business may be lower than assumed.

Reserves on IP insurance can be higher than those on, say, critical illness insurance, but are not usually large enough for investment profits / losses to be significant compared with those from the transition probabilities.

The above geared mainly towards non-linked contracts. On unit-linked business the general these of reduced risk for the insurance company would apply.

(b)

In its most extreme form, a policyholder could claim to be sick when, in fact, he or she was not. Naturally, insurance companies require some medical proof of sickness before allowing a claim, and so it is unlikely for such extreme fraud to go unnoticed. However, it is quite possible for the extent of some real condition to be exaggerated. This could happen, for example, at the start of a sickness claim, causing sickness payments to begin earlier than they should have done, or at the end of a sickness claim, causing payments to continue for longer than they should have done.

In the first case of transaction rate from healthy to sick has been increased; in the second case the transition rate from sick to healthy has been reduced.

(c)

(i) The design of the contract

Unit-linked designs could be made more capital efficient than non-linked designs. This could be quite significant. For example, contracts with reviewable charges (or reviewable premiums for conventional products) would be more capital efficient.

(ii) Premiums frequency

Usually this is mostly an issue of single versus regular premium. Individual contracts are usually regular premium, but this would be significant factor if single premium contracts were available.

(iii) Initial expenses

These could be significant, because of heavy underwriting. The additional complexity of the contracts may also increase other acquisition costs. For example, it may be necessary to pay higher commission to intermediaries.

(iv) Solvency margin requirement

This could be significant, because the greater unpredictability of sickness rates compared with death rates increases the risk.

[10]
[Any 3 (3)]

[2]……

[3]

(a)

The present value of future profits (PVFP for convenience) is $10a_{\overline{5}|} = 37.9$

So at the start of the year we have:

PVFP	Free assets	Embedded Value
37.9	100	137.9

What happens during the year? Suppose that experience is in line with assumptions. During the course of the year the free assets earn 8% interest. In addition, profit from the policy portfolio will flow through the revenue account into the free assets. So free assets at the need of the year will be.

100 x 1.08 + 10 = 118

What happens to the PVFP? It will increase by the risk discount rate, because the future profits are now one year closer; and it will decrease by the profit being transferred from it into free assets in that year. So

$PVFP_{end} – PVFP_{start}$ x (1 + risk discount rate) – profit in year

i.e., $PVFP_{end} = 37.9 \times 1.1 – 1.0 = 31.7$

This checks with what we should expect calculating $PVFP_{end}$ from scratch as $10a_{\overline{4}|} = 31.7$

So the picture at the end of the year is

PVFP	Free assets	Embedded Value
31.7	118	149.7

So the PVFP has decreased, free assts have increased and the embedded value has increased by 8.6%.

(b)

The PVFP will earn 10% by definition since it has been determined using a risk discount rate of 10%.

The free assets will earn 8%.

The total earnings of the two, given the relative sizes of the PVFP and the free assets, should therefore be around 8½%.

(c)

The actual growth will then vary depending on how experience compares with assumptions; but assumptions will be realistic, so the A v E effect should on average be zero.

This is a good example of how holding capital, as opposed to using it, dilutes the return obtained by the shareholders (*i.e.*, from 10% to 8.5%).

(d)

If experience is worse than expected, free assets will increase by less then the expected yield (*e.g.*, because there are extra claims to pay, or investment income is lower than expected, or capital values have plummeted) and the PVFP component will increase at a rate lower than the risk discount rate (for instance because, due to a high number of withdrawals, there are fewer policies around generating future profits). The converse is true if experience is better than expected.

(e)

The embedded value will increase if the business is profitable on the embedded value basis. The PVFP will increase, but free assets will normally decrease.

The impact of new business son this will depend on two things: the future profits we expect from the business over its lifetime, and the initial cashflow involved.

The overall impact of writing new business has been to increase the embedded value, although free assets have decreased. In effect, the free assets have provided capital to finance future profits. However, the present value of these future profits exceeds the initial capital required and so the impact is an increase in embedded value.

[10]

[4]

(i) Why lapse rtes are an important component of product pricing

Long-term contracts

If a healthcare insurance company pays a benefit upon surrender that is higher than asset share, the company will make a loss on that individual policy.

The same will happen on policies that pay no surrender benefit where asset share are negative…

…. which will normally be true at early policy durations when lapse rates also tend to be highest.

Similarly, paying a benefit which is less than asset share will give rise to a profit.

Lapse rates are also important for projecting future in –force volumes. For example, higher lapse rtes would mean that less profit would be expected from the portfolio later in the policy term, as fewer policies would still be in force.

Short-term contracts

Lapse rates are needed in order to assess the extent to which initial expenses can be spread over subsequent renewals. The higher the lapse rate, the fewer renewals are expected from each policy sold, and so the higher the premium loading for initial expenses needs to be.

All types

The impact on volume will affect the spreading of overhead expenses, and also of any fixed on-off expenses such as those for product development.

Lapses can be selective, taking out the healthy individuals from the portfolio and leaving the remaining policies subject to higher claim experience than was originally expected. The pricing morbidity assumptions must taken account of the expected effect of this.

When a company is pricing its products, it will want to quantify the profit that it expects to make as accurately as possible. Therefore, the company will want to allow for lapse experience in its models so as to reflect the financial impact, and to do so as accurately as possible.

If lapse rates are ignored, or are incorrectly allowance for, this would give a misleading indication of the profitability of the contract. This could also affect competitiveness and hence sale volumes.

(b)

The problem with predicting withdrawal rates is that they are heavily influenced by economic and commercial factors. For example, withdrawal rates can be influenced by:

- economic conditions, especially those affecting employment
- medial publicity
- comparison with competitors
- selling practices.

Significant events (*e.g.*, economic recession) occurring in the past lead to distortions in the past experience data, whilst future occurrences of such events are almost impossible to predict. It is, therefore, difficult or impossible to devise a future probability distribution for withdrawal rates with any degree of confidence, which makes a stochastic approach doubtful.

The best approach would probably be deterministic model for withdrawal rates, testing the effect of a whole range of possible outcomes (particularly at early policy durations).

[8]

[5]

The design of the group IP scheme needs to complement the benefits available from the occupational pension scheme.

The ill-health retirement benefits will cover the risk of an employee being unable to follow their normal occupation as a result of sickness or injury in the long-term, so the group scheme will need to cover short-term sickness absence, say up to two years.

The benefits should be calculated using a simple fixed formula so that they are related to the income received immediately prior to the claim period.

The total benefit should be limited, so that the income replacement ratio does not exceed 60-70%.

If the scheme benefits are to be paid to the employer then we can ignore statutory sick pay, otherwise it should be deducted from the benefit payable.

If membership of the scheme is required as a condition of employment, the underwriting cold be restricted to a simple criterion (*e.g.*, continuously at work in the two months prior to joining).

If membership is voluntary, then a similar underwriting criterion could be used for those who join at the first opportunity, otherwise a more detailed medical questionnaire would be needed.

Otherwise we would need to impose a free cover limit above which strict underwriting criteria would be applied.

If the employer is paying the premiums then a simple percentage of the total salary bill paid each month would be satisfactory. If individual members are paying their own premiums then a simple premium scale based on a percentage of gross salary and varying by age at entry would be satisfactory.

If the scheme has a very short deferred period for benefits (*e.g.*, 4 weeks), perhaps because the employer is using the scheme to cover the cost of statutory sickness benefits, then claims underwting will need to be more stringent than if the deferred period was longer (*e.g..*, 26 weeks).

In the latter case we should require any absence lasting longer than, say 4 weeks to be notified so that suitable support and conselling can be provided to reduce the likelihood of an eventual claim. This service is often seen as a positive aspect of the scheme by employers anxious to maximize the productivity of their workforce.

[12]

[6]

Solution

i) The basic premium for a policy without the option is P_{bas}, where:

$$p_{bas}\,\ddot{a}_{[45]:\overline{10}\urcorner} = 100{,}000A^{c}\frac{}{145:10}$$

where c indicate functions are calculated using the assumed total claim incidence rates.

In terms of the AM92 mortality functions this translates to:

$$p_{bas}\,\ddot{a}_{[45]:\overline{10}\urcorner} = 100{,}000A^{1}\frac{c1}{[55]:10\urcorner} = \left(A_{[55]} - v^{10}\frac{l_{65}}{l_{[55]}}A65\right)$$

This gives a premium of : P_{bas}, = 100,000x0.05926/8.228 = Rs.720.22.

ii) To find the value of the option benefits, we need to look at he value of the additional benefits incurred by taking out the option, and the value of the additional premiums charged.

The amount of the additional premium charged to cover the additional benefits is P_{add} where:

$$p_{add}\,\ddot{a}^{c}_{[50]:\overline{5}\urcorner} = 100{,}000A^{c1}_{[50]:\overline{5}\urcorner}$$

$$p_{add}\,\ddot{a}_{[60]:5} = 100{,}000A^{1}_{[60]:\overline{5}\urcorner} = 100{,}000\left(A_{[60]} - v^{5}\frac{l_{65}}{l_{[65]}}A65\right)$$

This gives a premium of Rs.919.81. Notes that we use the select claim basis here, because we will charge a premium for the additional benefits based on normal rates (*i.e.*, select rates).

The actual expected present value of these additional premiums (which means assuming that policyholders experience ultimate claim experience), is:

$$919.81\ddot{a}^{c}_{[50]:\overline{5}|} = 919.81\ddot{a}^{1}_{60:\overline{5}|} = 4{,}185.14$$

The value of the additional benefits is (again using ultimate claim experience):

$$100{,}000A^{1}_{[50]:\overline{5}|} = 100{,}000A^{1}_{[60]:\overline{5}|} = 100{,}000\left(A_{[60]} - v^5\frac{l_{65}}{l_{[60]}}A65\right) = 4{,}430.52$$

So the value of the option is the amount by which the expected present value of the benefits accrued exceeds that of the premiums to be paid, *i.e.*,

4,430.52 – 4,175.14 = 245.38

So the value of the option benefits at age 50 (when the option can e exercised) is Rs.245.38.

iii) We need to discount this value back to age 45:

$$245.38xv^5\frac{l^c_{50}}{l^c_{[45]}} = 245.38xv^5\frac{l_{60}}{l_{[55]}} = 245.38x0.799646 = 196.22$$

We now want to spread the premium for these benefits over 5 years. So the additional extra premium payable is P_{ex}, where:

$$P_{ex}\ddot{a}^{c}_{[45]:5|} = 196.22$$

i.e., $P_{ex}\ddot{a}^{c}_{[55]:5|} = 196.22$

This gives the additional annual premium for a policy with the option as Rs.43 pa.

[10]

[7]

Burning cost

The burning cost is the accumulation of claims in a recent year which might be taken as a first measure of premium adequacy.

	2005	2004
Claims paid during year	5,000	4,000
Reserve for claims reported but not settled (RBNS)	500	400
Reserve for claims incurred but not reported (IBNR)	200	150

Solution
The burning cost for 2005 is :

$$\{\text{claims paid}\} + \text{RBNS}_{2004} + \text{IBNR}_{2004} - \text{RBNS}_{2003} - \text{IBNR}_{2003}$$

$$= 5{,}000 + 500 + 200 - 400 - 150$$
$$= \text{Rs.}5{,}150$$

[5]

[8]

a)
A possible structure for the premium might be:

$$p^g = 4\sum_{i=1}^{n} i^g_{x_i s_i}\, s_i + E$$

where:

$i^g_{x_i s_i}$ = the claim incidence rte, under group scheme g, applicable to the i'th employee (aged x_i and of sex S_i)

S_i = the expected annual rte of salary for life I half way through the year.

E = loading for expenses and profit.

b)

(i) This will have one of the highest anti-selection risks, as people have a free choice about whether (and when) to take out health insurance cover. People who suspect they may have a medical problem could easily take out the cover before seeking medical advice, without failing the "actively to work" principle. The cost to the insurer could be considerable.

(ii) This is considerably less risky for the insurer, as many of the most serious medical conditions tend to be associated with older ages and, most likely, with people who have been at work for more than three years. There is still a potential risk from older new employees, though most of the firm's new recruits are likely to be young anyway.

(iii) This is probably the least risky approach. Covering all employees will mean that the average claim experience will reflect that of the workforce as a whole, and will not be concentrated on those lives presenting the highest risk. Delaying cover for one year means that all applicants for cover are likely to be genuinely good employment (and hence healthy) prospects.

(iv) Better than (i) and (ii) but worse than (iii). The latter is because the scheme does provide a way for unhealthy lives to "take up" work for a very short period before being able to claim under the group insurance scheme.

[7]

[9]

a)

(i) Income protection

This replaces lost income from earnings, so as index of national earnings (or one relating to the earnings of the particular occupation) would be best.

(ii) Critical illness

Thinking about the needs being met, critical illness benefits can be viewed as serving a range of possible purposes: to provide care, to repay debts, to replace lost income, to meet ongoing costs, *etc.*

These each suggest different things to link the benefits to, namely:

- care – inflation of medical treatment costs
- repay debts – no inflation (provided the debt is of fixed amount)
- income replacement – earnings inflation
- ongoing costs – price inflation

In practice the link would probably be to one the last three, possible also depending on the purpose of the policy (*e.g.* whether specifically required for repaying the mortgage on critical illness).

(iii)Pre-funded Long-term care insurance policies

Benefits under this policy are required to meet the costs of long-term care, which mostly relate to nursing and residential home costs. Linking the benefits to an index of such costs would seem to be the most appropriate link for policyholders.

In many cases, and especially for LTCI, companies put a ceiling on the rte of benefit inflation they will pay, in order to contain their costs to be within affordable bounds.

[K3=3]

b)

If the inflation of the relevant costs is higher than the fixed rate, policyholders may become under-insured. This is particularly a problem for any policy designed to meet specific costs, such as IP or LTCI. Policyholders may be very disappointed if their policies fail to cover the costs they were originally designed for. This leads to bad public relations, producing reduced future sales and/or higher lapse rates, leading to a significant marketing risk.

If the inflation of relevant costs is lower than the fixed rate, policyholders may become over-insured. This may make premiums too expensive, increasing lapse rates. Over-insurance is particularly a problem for IP policies, whose benefits may be capped at the time of claiming to keep benefits within the maximum permissible replacement ratio. Policyholders caught in this way could be seriously disgruntled, producing knock-on adverse marketing effects.

Overall the problems arise through the policy not meeting customer needs properly.

[6]

[10]

Immediate needs long-term care annuity

There is likely to be much uncertainty over:

- the length of time the policyholder will live.

- the rate at which claimants will move into higher care categories (if this leads to increased annuity payments under the contract).

Assumed mortality rates therefore need to be reduced.

Transition rates to higher care categories, where these exist, need to be increased.

Depending on how the benefits are defined under the policy, it may be that these will be affected by increases in long-term care costs (*e.g.*, nursing home fees), and may turn out higher than expected.

A higher inflation rate for benefit levels should then be assumed.

If policies are well matched by assets, then there will be a reduced need for a margin in the interest rate assumption.

However, the uncertainty over the duration (and possible amount) of future claim payments means that assets and liabilities may end up being significantly mis-matched.

Also, investment return is a significant component of future cashflow and so it would then be necessary to have a margin in this assumption. A reduction in the assumed investment return would be made.

Future expenses cold be higher than expected. This is especially true if changes in benefit levels are allowed under the contract when care needs change.

Higher expenses, and expense inflation, should again be assumed.

Private medical insurance

These are one-year contracts so they are effectively yearly renewable. Margins are therefore needed less than in the other contracts as the renewal premiums can be revised in the event of worsening claim and expense experience.

Margins will still be necessary, in order to make a profit. Higher than expected claim incidence rtes, expenses and average claim amounts could be used, or an explicit overall margin could be added.

A particular explicit margin be needed for the rate of rene4wals assumed when spreading the initial expenses. A lower than expected rate of renewal would be used.

Some claims (particularly the more expensive ones) may result in payments that continue for several years. In such cases, medical inflation will be an important influence on claims costs. We should assume a higher rate than expected in order to provide the margin.

Reserve will be small, and so the investment return will not be a significant factor. Therefore little loading will be needed for this.

[10]